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HOT AIR STERILIZATION OF DAIRY UTENSILS

S. HENRY AYERS AND COURTLAND S. MUDGE

From the Research Laboratories of the Dairy Division, United States Department of Agriculture

INTRODUCTION

It must first be pointed out that when sterilization of utensils is under discussion, the term "Sterilization" is not used in a strict bacteriological sense. Normally, of course, sterilization means the complete destruction of bacteria, but as commonly applied in the dairy industry it means the results obtained by the use of steam at about 212°F. Steam at this temperature should destroy nonspore-forming bacteria, if applied for a sufficient length of time, but spores of bacteria are not destroyed.

This point should be kept in mind in connection with the use of hot air for the sterilization of utensils. Therefore, in order to devise a process for the sterilization of utensils by hot air comparable with usual steam sterilization it is necessary only to employ a temperature sufficiently high to kill nonspore-forming bacteria.

Hot air has been extensively applied for a long time for the sterilization of glassware in the laboratory. For this purpose a temperature of about 350°F. has been employed for a period of one and one-half hours. In this process the object is to completely destroy all living organisms, both spore formers and nonspore formers. In other words, this process effects a complete sterilization in the strict sense of the term.

It seems probable that the possibilities of hot air sterilization of dairy utensils have been overlooked because of the very high temperature and long heating period necessary for *complete* sterilization. Furthermore, the knowledge that moist heat is much more efficient as a destructive agent has led to the use of flowing steam for the sterilization of dairy utensils.

THE BACTERIOLOGICAL PRINCIPLES OF HOT AIR STERILIZATION OF DAIRY UTENSILS

Throughout this paper the term sterilization is not used in a strictly bacteriological sense but is used as in the dairy industry as previously explained. If it were necessary to use a temperature of 350° F. for one and one-half hours, the use of hot air would at once become impractical.

The air, however, need only be at a temperature sufficiently high to destroy non spore-forming bacteria when utensils are exposed to it for a given period of time. Naturally the lower the effective temperature and the shorter the length of exposure the more practical will be the process.

Since it is only necessary to accomplish by hot air the same results obtained by steam at about 212° F. a field of possibilities is opened up.

Before hot air sterilization can be properly applied it is necessary to know the effect of hot dry air on bacteria, since the primary object of utensil sterilization is one involving bacteriology.

The following points are considered in this paper:

1. Temperature of hot air and heating period necessary to destroy bacteria.
2. Hot air sterilization of cans, where cans can be held, as at dairy farms.
3. Hot air sterilization of cans, where process must be continuous, as in plants.

It is realized that the results presented do not solve all the problems of hot air sterilization. The practical application is an engineering problem which, however, must be based on data of the nature of the kind given in this paper.

TEMPERATURE OF HOT AIR AND HEATING PERIOD NECESSARY TO DESTROY BACTERIA

As early as 1881 Koch and Wolffhügel (1) showed that spore-free bacteria were destroyed at a temperature of a little over 212° F. when heated for one and one-half hours. Spore formers,

on the other hand, were not destroyed by three hours' heating at 284° F. Since that time other investigations have shown that to destroy microörganisms a higher temperature is required with dry heat than with moist heat.

Before experimenting with the sterilization of utensils with dry heat it was considered advisable to determine its effect on different bacteria, and studies were made of three organisms, B. coli, a heat resistant lactic type of bacteria which was not a spore former, and a typical spore forming organism.

The cultures were grown on agar, then suspensions of the growth were made in sterile distilled water. Previously, a number of large bore test tubes had been prepared by inserting in them a strip of tin through a cotton plug, and the whole sterilized in the dry oven. The sterile strips of tin were then immersed in the suspension of bacteria, replaced in the tubes, and allowed to dry at about 90° F. Care was taken that these strips did not touch the walls of the test tube.

These tubes were heated in an oil bath and the temperature of the air surrounding the strips of tin was determined by a thermometer placed in a control tube immersed in the bath.

In the first experiments, a heating period of thirty minutes was chosen because this is about the average steaming period for dairy utensils on dairy farms which are equipped with a sterilizer.

After heating, the tubes containing the infected strips of tin were allowed to stand until the air had cooled to room temperature, then they were removed and placed in tubes of sterile litmus milk. Complete destruction of the bacteria was determined by the absence of growth in the milk tubes.

The results in table 1 are of interest because they show that spore-free bacteria were destroyed at temperatures which were relatively low, particularly in comparison with dry heat laboratory sterilization.

As will be noted, about ten minutes was required to raise the air temperature to the desired point and it was maintained at the temperature for thirty minutes.

B. coli was destroyed after thirty minutes heating at 160° F. in one test. In a second test it survived 160° F. but was de-

stroyed at 180° F. The thermal death point of this organism when heated in milk for thirty minutes is about 140° F. It is evident, therefore, that it is somewhat more resistant to dry heat. The thermal death point of B. coli is slightly higher when heated in milk than nonspore-forming pathogenic bacteria, so it seems reasonable to assume, that their resistance to dry heat would be no greater than B. coli.

The heat resistant lactic type of organism, while not a spore former, withstood a higher temperature when heated in milk than B. coli, its thermal death point being 168° F. when heated

TABLE 1

The effect of exposing bacteria to dry heat at different temperatures for thirty minutes

TEMPERATURE HEATED AT	TIME REQUIRED TO HEAT AIR TO THIS TEMPERATURE	CULTURE KILLED		
		B. coli	Heat resistant lactic type	Spore former
°F.	*minutes*			
140	8	No	No	
160	8	1st test—yes 2d test—no	No	
180	10	Yes	No	
212	13	Yes	No	
221			No	
230	10		1st test—yes 2d test—yes 3d test—yes	No
250	7		Yes	No
270	10			No

for thirty minutes. It was realized that organisms of this type which are commonly found in milk would also be on dairy utensils and because of their high resistance to moist heat a higher temperature dry heat would be necessary for their destruction than was required for B. coli.

This proved to be the case, as shown in table 1. This lactic type survived heating at 221° F., but was destroyed in each of three tests when heated to 230° F. for thirty minutes. Other experiments showed that this organism was destroyed when held at 230° F. for ten minutes when the time required to reach this temperature was nine minutes.

The spore-forming organism was not destroyed even when heated for thirty minutes at 270° F. This temperature is probably about as high as could be practically employed. The fact that spore formers survive such high temperatures should be no hindrance to the development of hot air sterilization because these resistant spores would not be destroyed by the usual process of steam sterilization now employed in the dairy industry.

It seems, from these results, that to make hot air sterilization successful for dairy utensils a temperature of only 230° F. need be employed when it is maintained for thirty minutes. This heating period could be employed at dairy farms or at any plant where the sterilization of utensils does not have to be a continuous process. It is, of course, out of the question where utensils must be sterilized in large numbers in a short space of time.

This brings up the question of quick heating with hot air. From a few experiments, the results of which are shown in table 2, it is evident that when the heating period was reduced a higher temperature was required to cause a destruction of the organisms.

The experiments were conducted in the same manner as previously described except that the heating period was varied. Tubes containing the infected strips of tin were heated gradually and a tube was taken out every minute and examined for the effect of the temperature reached on the culture. B. coli when heated in two minutes to 167° F. was destroyed. Evidently a short heating period and a low temperature is effective. The heat resistant lactic type, however, was not destroyed when heated to about 255° F. in a period of six minutes. It was destroyed when heated in seven minutes to about 273° F.

In this connection it is of interest to observe that this organism was destroyed by heating for ten minutes at 230° F., but in this case the culture had been subjected to a nine-minute heating period while the air temperature in the tube was being raised from room temperature to 230° F. This emphasizes the fact that there is a time and temperature factor to be considered.

It should be remembered that the method of determining the effect of heat in these experiments measured the absolute thermal death point of the organism, that is, the temperature at which every cell was destroyed. It is very probable that long before the temperatures cited were reached the majority of the bacteria were killed. In fact only a few cells may have resisted the highest temperature. This point is important in connection with the practical application of hot air sterilization.

TABLE 2

Effect of heating bacteria rapidly in dry air

HEATING PERIOD	HEATED TO	CULTURE KILLED	CULTURE
minutes	*°F.*		
1	129.2	No	B. coli
2	167.0	Yes	
3	194.0	Yes	
4	212.0	Yes	
5	224.6	Yes	
1	149.0		Heat resistant lactic type
2	195.8		
3	224.6	(Heated to 255.2°F. in 6 minutes.)	
4	240.8		
5	248.0		
6	255.2	No	
1	147.2		
2	197.6		
3	228.2	(Heated to 273.2°F. in 7 minutes.)	
4	249.8		
5	264.2		
6	269.6		
7	273.2	Yes	

HOT AIR STERILIZATION OF CANS, WHERE CANS CAN BE HELD AS AT DAIRY FARMS

From the data obtained in the experiments previously reported it seemed evident that on theoretical grounds, at least, good results could be obtained in utensil sterilization by an exposure to hot air at 230° F. for a period of thirty minutes. A process of this nature should be practical for use on dairy farms or any place where there is plenty of time for sterilization.

Experiments were, therefore, conducted with the sterilization of cans under laboratory conditions. An apparatus was constructed which consisted of a gas oven with a fan inside so arranged that it would blow air into an inverted can. Heat was supplied by a gas burner beneath the oven so that any desired temperature could be maintained. Determinations were made of the time required to heat the air in the can to the desired temperature with the fan running at a definite speed and the air entering the can at a known temperature. From these figures it was possible to place cans in the apparatus and heat them to any temperature desired and hold them for any length of time.

The cans used in the experiments were filled with milk which was allowed to sour in them. Sometimes cream was used in place of milk. The three 4-quart cans which were employed in each experiment were handled in the same manner except that two were sterilized for different lengths of time and the third was kept for a control. It was washed the same as the other two but not sterilized. The cans were washed in water at about 112° F. so as not to give a very efficient washing and to avoid destroying any bacteria through heat. No washing powder was used and the cans were not rinsed at all carefully. In fact the drippings from the cans when they went into the hot air sterilizer were milky. This type of washing was purposely employed in order that the cans would be in a condition worse than would normally be encountered. It was felt that if efficient sterilization could be obtained by hot air treatment with the cans in the condition as used in these experiments, then successful results could surely be expected under commercial conditions where the cans would be more thoroughly washed.

After sterilization, the cans were examined for bacteria by rinsing with 100 cc. of sterile water and plating. The bacteria in the control unheated can were determined in the same manner.

From the figures shown in table 3, it is evident that efficient sterilization was obtained when cans were heated for thirty minutes at 230° F. Six minutes was required to raise the temperature of the air in the can to this point. Heating for only fifteen minutes caused a very great reduction in bacteria but the

results were not so uniformly good. It should be noted that the figures represent the number of bacteria per 4-quart can and not the number on the plates.

In one experiment cream was allowed to sour in the cans for four days. In this case, as will be noted, special methods were used to detect yeasts and molds. The yeasts were destroyed at both holding periods and for practical purposes the same might be said of the molds. The numbers of the organisms being 200 and 100 per can represent two and one colonies on each plate.

TABLE 3

The destruction of microörganisms in milk cans by exposure to dry air at 230°F.

SERIES NUMBER	CONTENTS OF CAN BEFORE WASHING	NUMBER BACTERIA PER CAN		
		Washed	Heated 15 minutes	Heated 30 minutes
1	Sour milk	3,400,000,000	100	100
2	Sour milk	510,000,000	300	100
3	Sour milk	3,600,000,000	300	400
4	Sour milk	760,000,000	1,800	600
5	Sour milk	1,080,000,000	500	800
6	Sour cream	222,000,000	400	400
7	Sour milk	1,400,000,000	800	200
8	Sour milk	1,570,000,000	1,500	200
9	Sour milk	1,500,000,000	4,000	200
10	Sour milk	3,110,000,000	4,200	400
11	Sour cream, 4 days old	1,100,000,000	21,700	400
11		Yeasts: 18,000,000 Molds: 7,000,000	Yeasts: 0 Molds: 200	Yeasts: 0 Molds: 100

These might easily have been contaminations which are commonly observed in these laboratories. In all the experiments the cans were completely dry after the heating process. They dried very rapidly when the air temperature reached 212° F.

It is believed from these results that hot air at 230° F. for a period of thirty minutes can be used satisfactorily for the sterilization of dairy utensils. Moak (2) reports the use, with excellent results, of dry heat for sterilization on a certified milk farm. From his paper it seems that a temperature of about 270° F. was employed for two hours. The results of our experiments

indicate that it is not necessary to use such high temperatures and that thirty minutes' heating is sufficient. This would naturally reduce the cost of the sterilizing process.

HOT AIR STERILIZATION WHERE PROCESS MUST BE CONTINUOUS AS IN MILK PLANTS

The application of hot air sterilization in plants where a large number of cans have to be handled in a short time presents an entirely different problem from that of the dairy farm. In this case it is a question not only as to whether it is possible to obtain a satisfactory sterilization in a few minutes but also whether it can be done on a practical scale. Only the first problem will be considered in this paper, namely, is it possible to sterilize cans by hot air in a few minutes time?

From results reported earlier in this paper it was evident that if the holding period was reduced the temperature must be raised. Acting upon this information the temperature first used was 248°F. Cans were treated in the same manner as when held for thirty minutes at 230° F., but in this series of experiments the air in one can was raised to a temperature of 248° F. in four minutes and the other can, heated to this temperature in the same length of time, was held at it for two minutes. The unheated control can was treated as usual.

The results in table 4 show that a great destruction of bacteria took place when the air in the cans was raised from about 112° F., the temperature after washing, to 248° F. in four minutes but the results were not uniformly low. When held two minutes, making a total heating period of six minutes, much better results were obtained. In one experiment it was found that the yeasts were destroyed and the molds practically so.

The results obtained with the four-minute heating and two-minute holding periods were not as good as those obtained when a temperature of 230° F. was employed and maintained for thirty minutes. It must be remembered, however, that the cans were in an extremely bad condition and this heating process might prove satisfactory if the cans were properly washed.

Another series of experiments was conducted, using an air temperature of 266° F. In this case the time required to heat the air in the cans to this temperature was five minutes. One can was merely raised to 266°F. and the other held two minutes

TABLE 4

The destruction of microörganisms in milk cans by exposure to dry air at 248°F.

SERIES NUMBER	CONTENTS OF CAN BEFORE WASHING	NUMBER BACTERIA PER CAN		
		Washed.	Heated to 248° F. in 4 minutes	Heated to 248° F. in 4 minutes and held 2 minutes
1	Sour milk	51,000,000	300	300
2	Sour milk	17,300,000	6,200	3,700
3	Sour milk	33,000,000	2,000	300
4	Sour milk	1,050,000,000	700	100
5	Sour milk	1,540,000,000	241,000	90,000
6	Sour milk	600,000,000	1,100	500
7	Sour milk	1,310,000,000	3,200	100
8	Sour milk	1,280,000,000	15,600	400
9	Sour milk	2,500,000,000	54,900	900
10	Sour milk	98,000,000	600	0
11	Sour cream, 4 days old	370,000,000	1,600	1,000
11		Yeasts: 1,290,000 Molds: 550,000	Yeasts: 0 Molds: 100	Yeasts: 0 Molds: 100

TABLE 5

The destruction of bacteria in milk cans by exposure to dry heat at 266°F.

SERIES NUMBER	CONTENTS OF CAN BEFORE WASHING	NUMBER BACTERIA PER CAN		
		Washed	Heated to 266° F. in 5 minutes	Heated to 266° F. in 5 minutes and held for 2 minutes
1	Sour milk	5,700,000,000	1,000	600
2	Sour milk	2,300,000,000	3,600	100
3	Sour milk	2,400,000,000	700	300
4	Sour milk	1,280,000,000	7,800	100
5	Sour milk	2,100,000,000	13,300	900

at this point. Here again, as may be seen from table 5, the effect of the two-minute holding period could be observed and the results were very satisfactory.

One more series of experiments was tried in hopes of being able to reduce the heating period to four minutes by increasing

the temperature. In these experiments a temperature of 284° F. was employed and the air in one can was raised to this point in four minutes. Another can was heated in the same time and held two minutes at this temperature.

The results in table 6 show that in both cases good reductions were obtained, although here again the value of the two-minute holding period at 284° F. was manifest. The greater efficiency

TABLE 6

The destruction of microörganisms in milk cans by exposure to dry air at 284°F.

SERIES NUMBER	CONTENTS OF CAN BEFORE WASHING	NUMBER BACTERIA PER CAN		
		Washed	Heated to 284° F. in 4 minutes	Heated to 284° F. in 4 minutes, then held 2 minutes
1	Sour milk	450,000,000	2,000	100
2	Sour milk	730,000,000	200	300
3	Sour milk	900,000,000	200	200
4	Sour milk	410,000,000	700	200
5	Sour milk	660,000,000	1,000	600
6	Sour milk	1,010,000,000	1,900	200
7	Sour milk	2,100,000,000	500	100
8	Sour milk	1,260,000,000	2,400	700
9	Sour milk	1,390,000,000	400	400
10	Sour milk	530,000,000	400	700
11	Sour cream, 5 days old	960,000,000	400	300
11		Yeasts: 1,900,000 Molds: 4,000,000	Yeasts: 0 Molds: 100	Yeasts: 0 Molds: 100

of 284° F. over 248° F. is shown by comparison of the bacterial reductions in tables 4 and 6. This is particularly true when the air in the cans was merely heated to the temperatures indicated. In all the experiments the cans came out perfectly dry.

An interesting point is indicated by the results of these experiments, namely, that to obtain effective sterilization a certain minimum length of exposure seems to be necessary. While the holding period can be reduced as the temperature is increased there seems to be a point beyond which the increase in temperature does not permit of a proportionate decrease in the holding period.

SUMMARY

1. The destructive effect of hot air on various types of bacteria is shown.

2. A temperature necessary for effective sterilization of utensils has been determined which seems to make the process of hot air sterilization practical for dairy farms or plants where utensils can be held.

3. The temperature of hot air necessary to cause sterilization in from four to six minutes has been determined.

4. No definite facts have been presented to show the value of hot air sterilization from a practical standpoint. The results merely point out some of the fundamental facts upon which rest the commercialization of the process. This is an engineering and economic problem.

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A RAPID ACIDITY TEST FOR GRADING MILK[1]

ROSCOE H. SHAW

Research Laboratories, Dairy Division, Bureau of Animal Industry, United States Department of Agriculture, Washington, D. C.

Some time ago the author was called upon to devise a quick acidity test for use in the condensery department of the Grove City, Pa., Creamery. A test was required that could be used in the receiving room to indicate whether a certain can or lot of milk was within a fixed limit in acidity. The ordinary method of titrating with $\frac{N}{10}$ alkali is entirely too slow for the purpose. The test herewith described was in successful use for several years and is presented with the thought that it may be useful to others having similar requirements. No special originality is claimed for the two small dippers, since it is understood that somewhat similar dippers have been in use for some time in certain establishments.

Two small dippers of equal capacity and preferably of brass are required, one for measuring the milk and the other for measuring the special alkali solution. Fifteen or 20 cc. is a convenient size. The one for milk should be provided with a handle long enough to reach down into a milk can, while the handle of the other should be about 6 inches long.

The special stock alkali solution contains 17.777 grams of sodium hydroxide per liter[2] and is of such strength that when 50 cc. of it is diluted to 1 liter with distilled water, making what may be termed the working alkali solution, unit volume of the latter will exactly neutralize the acid in unit volume of milk of 0.2 per cent acidity. This working alkali is a flexible one. It can be adjusted for any desired acidity of milk by simply using more or less of the stock alkali solution when making it

[1] Published by permission of the Secretary of Agriculture.

[2] This solution must be carefully prepared. Since sodium hydroxide absorbs moisture from the air, it cannot be made by simply weighing out 17.777 grams, dissolving, and diluting to one liter. If a chemist is not available the solution should be purchased from a reliable chemical or creamery supply house.

up. For example, if it be desired to have the working solution of such strength that unit volumes of it and 0.22 per cent acidity milk will neutralize, then instead of diluting 50 cc. of stock solu-

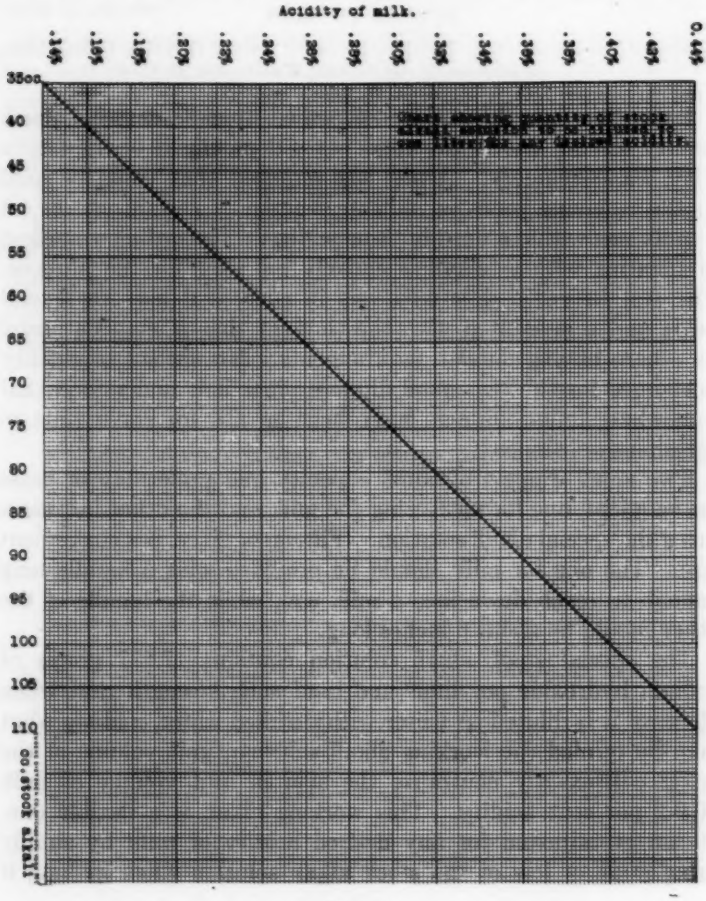

CHART 1

tion 55 cc. would be used. The accompanying chart shows the quantity of stock solution to be diluted to one liter for any desired acidity of milk.

In preparing the working alkali solution the proper quantity of the stock alkali solution should be carefully measured from a burette into a liter volumetric flask and then distilled water at room temperature added to the mark. Shake the mixture well. For convenience it can be poured into a large beaker into which the brass dipper can easily be submerged. Only enough of the working alkali solution for one day's run should be made up. If any is left it should be thrown away.

The manner of using the test will at once be apparent. Simply lower the milk measuring dipper into a can of milk and pour contents into a white cup or white enamelled dipper. Add a few drops of phenol-phthalein solution (1 per cent in alcohol). Now pour in a dipperful of the working alkali solution and mix by pouring into another white cup or enamelled dipper. If the working alkali solution was prepared for 0.2 per cent acidity milk then the milk will remain pink if it is less than 0.2 per cent acidity and it will become colorless if it is 0.2 per cent or more. Perhaps a better way is to add the indicator to the working alkali solution while making it up. If this is done enough should be added before making up to the mark to color the solution an intense pink. The amount to use can be learned only by experience, but 2 cc. of the phenol-phthalein solution is suggested.

It is suggested that the test be checked up with the titration method before it is relied upon finally, for it must be remembered that the personal equation plays an important part in testing milk for acidity. To some eyes milk will have a decided pink tint, while to others it will appear colorless. It must also be taken into account that the working alkali solution is dilute (about $\frac{N}{45}$) and four or five drops will be required to produce the same color change that one drop of $\frac{N}{10}$ alkali will produce. Consequently it is quite possible that with milk testing 0.19 per cent or even 0.18 per cent acidity the special test will show a colorless milk to some operators when it should show a pink tint. In such cases it will be necessary to increase the strength of the working alkali solution until it does react at 0.2 per cent acidity. If this be done a proportionate increase must of course be made for all other acidities.

The stock alkali solution is rather concentrated and unless care be taken the glass cock in the burette will stick. It is not advisable to let the alkali solution remain in the burette after using. It is best to pour what remains back into the bottle and rinse out the burette with water.

In testing cream for acidity it will be necessary to rinse out the dipper with water and add the rinsings to the charge. Cream, being more viscous than milk, will adhere more to the walls of the dipper.

PERFORMANCE IN SOME OF THE LEADING GUERNSEY SIRES

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INTRODUCTION

The continuous improvement of the herds of live stock in the country depends upon the elimination of the unfit and the selection for mating of those individuals which possess in the highest degree the desirable character sought and which are still further endowed with the power to transmit their qualities to their offspring. Two things are therefore necessary to be determined in the systematic selection of animals and in the improvement of breeds. First, it must be determined which are the superior individuals of the breed and second, so far as possible, it must be ascertained with what degree of force and uniformity these animals transmit their productive qualities and capacity. Especially is this true of the sire since the relative influence of the male, because of his opportunity, is so much greater than is the influence of any single female.

In order that one may obtain the greatest success in breeding dairy cattle, it is necessary that he should have some definite plan of breeding, some definite method by means of which males and females, especially the former, may be selected. Some means should be provided whereby the leading productive strains may be located and their prepotency, so far as concerns production capacity, indicated by some measurable quantity. It was with the idea of studying the transmitting power of some of the leading Guernsey sires that this work was undertaken. It is intended to continue this research so as to include a similar study of the transmitting power of these bulls through their sons' daughters. This paper is therefore presented not as a concluded work but as a report of work still in progress.

MATERIAL

All Guernsey bulls having 25 or more daughters in the Advanced Registry up to July 1, 1918 were studied. To this list of bulls was added Ne Plus Ultra because of the present strong demand for his progeny and also because of the fact that he was owned by Mr. S. M. Shoemaker of Eccleston, Maryland, one of the leading Guernsey breeders of the state. Altogether 14 bulls were included in the study. The following is an alphabetical list of the bulls regarding which data were collected. The number preceding the name of the bull indicates the number by which that bull should be known throughout this discussion. The first number following the name of the bull is his herd book number. The number in parenthesis designates the number of Advanced Registry daughters which he has. Following this is the date of birth:

1. Cora's Governor of Chilmark (Imp) 8971 (40).....May 5, 1903
2. Galaxy's Sequel (Imp) 16904 (40).....June 12, 1904
3. Glenwood Boy of Haddon 4605 (26).....February 11, 1895
4. Glenwood's Main Stay 6067 (26).....May 13, 1899
5. Golden Noble II R. G. A. S. 1836 P. S. (26)....November 21, 1905
6. Governor of the Chene R. G. A. S. 1297 P. S. (76)..September 5, 1900
7. Justinee's Sequel of the Preel R. G. A. S. 2119 P. S. (35) September 26, 1907
8. King of the May (Imp) 9001 (25).....February 6, 1903
9. Lord Mar (Imp) 14359 (27).....May 10, 1905
10. Masher R. G. A. S. 63 F. S. (31).....May, 1904
11. Masher's Sequel (Imp) 11462 (68).....April 14, 1900
12. Ne Plus Ultra 15265 (20).....June 23, 1909
13. Prince of Groton 9841 (26).....December 18, 1902
14. Princess's Jewel (Imp) 25877 (28).....January 6, 1906

Of these 14 bulls 10 were bred on the Island of Guernsey. Six have been imported. Nine of these bulls belong to four great Guernsey families, namely, Governor of the Chene, Masher, Glenwood Girl, and May Rose. The daughters of these 14 bulls have 631 advanced registry records to their credit. The calculations herein contained, therefore, include 631 individual butter fat records.

METHOD

It is coming more and more to be recognized that dairy bulls should be selected on the basis of performance, rather than upon some other abstract quality. While no definite standard for measuring performance has yet been uniformly adopted, it is, however, very generally agreed that performance in the bull should be measured by his ability to endow his daughters with the power of high milk or high butter fat production or both.

A number of different methods of expressing the relative productive capacity of bulls have been used at different times. Among such methods the following may be enumerated:

1. The total number of advanced registry daughters which a bull has.

2. The number of daughters that a bull has that have exceeded some arbitrary high production standards, such as 500 or 600, pounds of butter fat per year.

3. The number of daughters equivalent to 1000, 800, 600 etc., pounds of butter fat per year calculated on the basis of the yearly advanced registry requirements for the class or age.

4. The percentage production of all advanced registry daughters based upon the standard advanced registry requirements according to age.

The first method of comparison is open to the very serious criticisms that both the age and the opportunity of the bull which very materially effect results are not taken account of.

Methods two and three are open, in a degree, to somewhat the same objections as method one. These methods are also objectionable because of the fact that emphasis is placed upon extreme variation in production rather than upon high average yield. By calculating the results secured in methods two and three in terms of percentage of total number of advanced registry daughters which are high producers, we may, in a measure, eliminate the effects of age and opportunity but too much emphasis is still placed upon the upper extremes of production.

The fourth method takes into consideration the production of every tested daughter thus eliminating the effects of age and

opportunity. This method also has an added advantage over the others in that it points out the bulls whose daughters have the highest average of production. The most valuable bull from the standpoint of breed or herd improvement is not the bull that is the sire of a few exceptional individuals, the remainder of his female offspring being perhaps inferior, but it is the one whose daughters are possessed, on the average, of the highest degree of production. The fourth method of comparison is the system followed in this study as it is felt that this method is more free from criticism than the others.

DISCUSSION

The daughters of each bull were grouped, following the Guernsey Advanced Registry Classification, into their respective age classes. Table I gives the Age Classes with their respective age limits together with the standard production requirement assumed for each class.

TABLE 1

CLASS	AGE LIMIT	YEARLY BUTTERFAT REQUIREMENT
A	5 years or over	360.0
B	4½ to 5 years	341.8
C	4 to 4½ years	323.5
D	3½ to 4 years	305.3
E	3 to 3½ years	287.0
F	2½ to 3 years	268.8
G	Under 2½ years	250.5

An example will serve to illustrate the method of calculating the rate of production per individual based on the standard requirement for the class. If a cow under two years and six months of age produces 501 pounds of butter fat per year her percentage of production is $200\left(\frac{501}{250.5} \times 100\right)$. The average percentage production of each bull is obtained by getting the average percentage production of all his daughters.

In any method of comparison there is no possible way of eliminating or measuring the effects of factors such as the quality

of cows with which the individual bulls were mated, the environmental conditions under which the tests were conducted, the production of untested daughters or of tested daughters who failed to make at least the minimum advanced registry requirements set by the Association. It is unfortunate, but of necessity it is true, that this or any similar study must be made of a more or less selected population. Any method of comparison to be absolutely comparable would require that all bulls under

TABLE 2

NUMBER OF BULL	NUMBER OF RECORDS	PER CENT VALUE	A		B		C		D		E		F		G	
			Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent
1	52	160	6	183	3	177	6	162	4	143	5	149	7	140	21	164
2	49	151	15	143	1	128	2	158	8	152	7	161	12	155	4	147
3	48	153	13	147	3	171	3	146	5	144	4	218	5	127	15	155
4	45	137	9	147			4	132			3	154	3	115	16	134
5	38	168	17	155	3	171	2	168	6	186	2	216	4	170	4	167
6	101	158	27	140	10	141	11	147	13	152	8	145	13	155	19	159
7	38	151	4	132	3	118	3	104	5	146	7	166	7	151	9	167
8	30	211	7	185					2	222	2	194	3	234	16	218
9	39	160	5	125	2	142	6	182	5	144	5	186	6	160	10	155
10	32	128	9	136	2	131	2	123	5	151	8	115	6	117		
11	83	139	32	138	4	121	4	132	13	138	8	137	18	155	4	134
12	28	193	1	190	1	180	1	202	3	170	3	195	5	202	14	196
13	29	128	23	126	2	137			2	135					2	143
14	33	148	10	148	2	119	5	154	2	143	4	142	4	140	6	166
Average	631	158	178	144	36	144	49	153	63	176	66	158	93	155	136	171

consideration be bred to the same cows and that all offspring be reared, developed and tested under the same environmental conditions, which obviously is impossible.

Table 2 gives the number of records obtained by the daughters of each bull, the average percentage production of all of the daughters of each bull and the average percentage production of the daughters of each bull by age classes. At the bottom of the table is given the average percentage value of each class. This value was secured by taking a weighted average.

Arranging the 14 bulls in descending order according to the average percentage production of their daughters, they rank as follows:

8. King of the May	211
12. Ne Plus Ultra	193
5. Golden Noble II	168
1. Cora's Governor of Chilmark	160
9. Lord Mar	160
6. Governor of the Chene	158
3. Glenwood Boy of Haddon	153
7. Justinee's Sequel of the Preel	151
2. Galaxy's Sequel	151
14. Princess's Jewel	148
11. Masher's Sequel	139
4. Glenwood's Main Stay	137
10. Masher	128
13. Prince of Groton	128

King of the May, the percentage production of whose daughters is 211, heads the list. King of the May is followed by his grandson Ne Plus Ultra whose value is 193. Golden Noble II comes third with a value of 168. Governor of the Chene, who has more daughters in the Advanced Registry than any other Guernsey Bull, stands sixth. Masher's Sequel, who for a long time ranked first in the number of advanced registry daughters, stands eleventh.

An inspection of table 2 will show that cows in classes "A" and "B" have lower percentage values than cows in the other classes. The data here presented would tend to indicate that it is hardest for mature cows and senior four years olds and easiest for senior three and junior two year olds to meet or exceed the present advanced registry requirements of the breed. The mature cows and senior four years olds exceed the requirements by only 44 per cent whereas the senior three year and the junior two year olds exceed the standard by respectively 76 per cent and 71 per cent. Consequently, those bulls having a large proportion of their tested daughters in classes "A" and "B" are at a distinct disadvantage when the present standards of fat production are the basis of comparison.

While the data presented in table 2 is too limited in amount to permit of the drawing of any definite conclusions, the indications are, taking the average percentage production of each age class as the basis of comparison, that the present standard requirements of the breed associations are not comparable for all age classes. For example: Classes "A" and "B" each exceed the standard requirement by only 44 per cent whereas Classes "D" and "G" exceed the standard by 76 per cent and 71 per cent respectively. If the present standard requirement of 360 pounds of butter fat for the mature class is maintained, the

TABLE 3

BULL	A		B		C		D		E		F		G	
	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent
1	6	11.5	3	5.8	6	11.5	4	7.7	5	9.6	7	13.5	21	50.0
2	15	30.6	1	2.0	2	4.1	8	16.3	7	14.3	12	24.5	4	8.3
3	13	27.1	3	6.3	3	6.3	5	10.4	4	8.3	5	10.4	15	31.3
4	9	25.7			4	11.4			3	8.6	8	8.6	16	45.7
5	17	44.9	3	7.9	2	5.3	6	15.8	2	5.3	4	10.5	4	10.5
6	27	26.7	10	9.9	11	10.9	13	12.9	8	8.0	13	12.9	19	18.8
7	4	10.5	3	7.9	3	7.9	5	13.2	7	18.4	7	18.4	9	23.7
8	7	23.3					2	6.7	2	6.7	3	10.0	16	53.3
9	5	12.9	2	5.1	6	15.4	5	12.9	5	12.9	6	15.4	10	25.7
10	9	28.1	2	6.2	2	6.2	5	15.6	8	25.0	6	18.8		
11	32	28.6	4	4.8	4	4.8	13	15.7	8	9.6	18	21.7	4	4.8
12	1	3.6	1	3.6	1	3.6	3	11.7	3	11.7	5	17.9	14	50.0
13	23	79.3	2	6.9			2	6.9					2	6.9
14	10	33.3	2	6.7	5	15.2	2	6.7	4	12.1	4	12.1	6	18.1

requirement for the other age classes are undoubtedly all too low, and, in order to place all age classes on an equal basis, should be increased. Further study, however, is necessary to accurately determine what the standard of the age classes should be.

In determining the respective productive capacity of two or more bulls, both the average percentage production and the distribution of his daughters as to age classes should, therefore, be taken into account.

Table 3 gives the number and percentage distribution of the daughters of each bull according to age classes.

Bull no. 8, King of the May, has 63.3 per cent of his daughters in classes "F" and "G." Bull no. 12, Ne Plus Ultra, has 67.9 per cent of his daughters in the same two classes. These two bulls head the list. Bulls no. 10 and no. 13, who are at the bottom of the list have only 18.8 per cent and 6.9 per cent respectively in classes "F" and "G." On the other hand, respectively 34.3 per cent and 86.2 per cent of their daughters are in classes "A" and "B." It will be seen from the data here presented that there is quite a wide variation in the percentage distribution of

TABLE 4

Percentage distribution of the records of the daughters of the 14 bulls

NUMBER OF BULL	NUMBER OF RECORDS	100 TO 120 PER CENT	121 TO 140 PER CENT	141 TO 160 PER CENT	161 TO 180 PER CENT	181 TO 200 PER CENT	201 TO 225 PER CENT	226 TO 250 PER CENT	OVER 250 PER CENT
1	52	7.7	21.2	25.0	15.4	21.2	9.6		
2	49	12.2	30.6	24.5	16.3	10.2	6.1		
3	48	14.6	27.1	25.0	20.9	4.2	2.1	2.1	4.2
4	35	25.7	28.9	25.7	17.1			2.9	
5	38	7.9	21.1	10.5	28.9	5.3	18.4	5.3	2.6
6	101	16.2	27.3	26.3	26.3	4.0	1.0	1.0	
7	38	15.8	21.1	21.1	21.1	10.5	7.9	2.6	
8	30		6.6	3.3	6.6	16.6	33.3	16.6	16.6
9	39	10.3	17.9	28.2	20.5	12.8	7.7	2.6	
10	32	50.0	25.0	9.4	12.5	3.1			
11	83	20.5	31.3	20.5	13.3	7.2	2.4		
12	26		3.6	3.6	25.0	28.6	28.6	7.2	3.2
13	29	31.0	44.9	24.1					
14	33	15.2	27.3	36.4		3.3	3.3	3.3	

the daughters of different bulls in the several age classes. However, considering this diversity of distribution in conjunction with the differences in percentage productions of daughters, it is doubtful, so far as these 14 bulls are concerned, if the rank of the bulls on the percentage production of daughters only would be materially changed.

Table 4 gives the percentage of the records of the daughters of each bull falling within the several production groups, each group being based upon the percentage by which the records of the daughters exceed the breed standard.

Of the 52 records of the daughters of bull no. 1, 7.7 per cent have exceeded the breed standard by 100 to 120 per cent; 21 per cent by from 121–140 per cent; 25 per cent from 141 to 160 per cent, etc. Only four of the 14 bulls have produced daughters exceeding the breed requirements by over 250 per cent. The most frequent distribution is found in the group 121 to 140 per cent. On the average, 23.8 per cent of the records fall in this group. 20.2 per cent of the records fall in group 141 to 160 per cent and 18.7 per cent fall in group 161 to 180 per cent. Therefore, 62.7 per cent of all records fall in these three groups.

SUMMARY

There are a number of different methods available for studying the performance or productive capacity of bulls, taking the production of their daughters as a basis for comparison. The method which appears to be the most free from criticism is to make a comparison using as a measure of performance the percentage production of all advanced registry daughters based upon the standard advanced registry requirements according to age.

There is a great difference in the production capacity of bulls as indicated by the records of their daughters. King of the May and Ne Plus Ultra have performance records of respectively 211 per cent and 193 per cent while Masher and Prince of Groton have performance records of only 128 per cent. The average production for all the daughters of all bulls is 158 per cent.

It is to be preferred that a bull be selected upon the basis of his performance as indicated by the production capacity of his daughters rather than upon his individuality or lineage. Individuality and lineage indicate what the breeding capacity of a bull may be; performance is a measure of what he actually is. The ideal combination is, of course, excellent individuality, strong ancestry, and superior performance. It is hardest for cows in classes "A" and "B" and easiest for cows in classes "D" and "G" to meet or exceed the advanced registry requirements. Cows in classes "A" and "B" exceed the requirements by only

44 per cent whereas the cows in classes "D" and "G" exceed the requirements by 76 per cent and 71 per cent respectively.

Owing to the fact that the present breed requirements for the various age classes are not entirely comparable, the apparent productive capacity of a bull should be considered with reference to the distribution of his daughters in the various classes.

The largest proportion of the records made by the daughters of the 14 bulls falls within the groups producing from 121 per cent to 180 per cent production based upon the standard requirement for the breed. Approximately 63 per cent of all records fall within these groups.

ACIDITY AND QUALITY

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Methods of making butter are the result of ideals and conditions. Originally butter was made on the farm. As enough cream to make a churning was being accumulated it soured spontaneously. About one-half of our butter supply comes from cream soured and churned on the farm. The other half is made in creameries and also from sour cream. The majority of this cream is also soured on the farm.

Buttermaking is the pioneer dairy industry. Concentration of population in large cities forces the butter territory farther away. The vicinity of Elgin no longer produces butter. Its dairy product is sold as market milk. New York City reaches 400 miles for market milk and cream and many so-called "creamery" in New York state is only a milk and cream shipping establishment. Cheese factories, condenseries, and milk powder plants crowd the butter maker farther and farther from the large consuming centers. Since these dairy plants can pay a better price they choose the best developed territory with the best volume. Thus the creamery is always the vanguard of dairy manufactures. Early writers on American dairying regarded it confined to a "Dairy Belt" lying between the fortieth and forty-fifth parallels and the Atlantic Ocean and Missouri river. This strip is north of Columbus, Ohio, and south of St. Paul, Minn. In the last ten years the relative increase in production of creamery butter has been much greater outside of this "Dairy Belt" than within it. Inability of production of butter to keep up with the increase in population has crowded buttermaking into less favorable territory and into hands of farmers who never before were creamery patrons.

Not only was the butter produced near the points of consumption but our grandmothers brought it directly home as purchased. It did not have to make a round trip of the city

in a delivery wagon. More of it went directly from the farm to the consumer. Now wholesalers of butter and the rapidly growing chain stores prefer butter whose uniformity and keeping quality are dependable.

A generation ago there was a surfeit of butter in the summer and a butter famine in the winter. Now cold storage tends to equalize these extremes.

In the meantime the cost of farm labor has risen to such a figure that the farmer carefully considers where to apply his labor and whether to employ outside labor.

The foundation of a creamery is an economic one. It persuades the farmer that it can make better butter and cheaper than he can. The creameries have convinced the farmers furnishing butterfat for the 600,000,000 pounds of creamery butter that this is true. Creameries are going into the remotest corners of the land and striving to convince the farmers making 900,000,000 pounds of farm butter that it would be better for them to shunt this work upon the creameries.

Hence, the following facts stand out prominently:

1. Marketing at long range and cold storage created a new requirement for butter: Keeping quality. This is appreciated more and more.

2. Taking possession of the best dairy territory by more intensive dairy manufactures and the increasing cost of farm labor have made it more difficult to care for cream and more difficult to deliver it frequently.

3. Increasing scarcity and the rising price of butter have caused creameries to solicit cream wherever it may be found. Creameries propogandize for more cows, better cows, better fed cows, and better quality of cream.

High cost of labor is rapidly forcing wholemilk creameries to give way to cream creameries. Even in Minnesota, the field of the wholemilk creameries, they are a small minority. Cream produced on farms furnishes practically all of our butter supply. A large part of this cream is received sour. All creameries want good cream. They would rather have the cream sweet. They make great efforts to improve the quality of cream. Education,

persuasion, and prices are available as means for bringing about improvement. Good sour cream makes ninety point butter. If the bulk of sweet cream butter scored 93, it would be doing better than it is doing. This improvement in quality usually brings two cents a pound more for the butter and sometimes three. Assuming that a cow produces one-half pound of butterfat daily the extra pay for better care and for going to town before the cream sours, say every day or every other day, is 4 cents a day for four cows; 40 cents a day for ten cows; 80 cents a day for twenty cows.

It is obvious that the question whether the increase in price is a sufficient inducement depends on the size of the herd. Many states average less than four cows per farm. Clubbing or the operation of routes in those localities where it is feasible greatly increases the premium available for sweet cream. Paying a better price for better cream is economically and morally right.

A small volume of dairy butter sells at fancy prices, say a dollar a pound, and some creamery butter is reported to bring premiums as high as ten cents a pound. Every creamery that can sell its butter at this advantage should do so and we are told that the supply of this butter is not equal to the demand. I believe that the number of consumers who will pay ten cents more than the prevailing price is very small. Indeed, the rich people who have been eating oleomargarine for patriotic reasons or to help bring down the price of butter are much more conspicuous. I have never seen any fancy priced butter on sale in Chicago. I have eaten at most of the public eating places in America. I am seldom served with fancy butter. It is usually good ordinary butter.

Butter possessing good keeping quality is preferred by buyers. If it does not have keeping qualities its flavor is uncertain and cannot be uniform. Butter that remains eatable for two weeks at approximately 65° or for four to six months in cold storage is a good keeper. The following are requisites for good keeping: (1) Low acidity, (2) pasteurization, (3) elimination of buttermilk, (4) proper working.

Butter from the freshest and sweetest cream does not keep well unless pasteurized. Even if sweet and pasteurized it does not keep well if overworked or if the buttermilk is not well eliminated. Thus in spite of supposedly good material much butter keeps poorly. The economic and hygienic need of pasteurization is obvious.

If sour cream is pasteurized the butter has a scorched flavor, a high curd content, the loss of fat in churning is heavy (often 3 per cent) and often the cream curdles or becomes ropy. In fact, heating sour cream makes cottage cheese out of it but the curd is usually so finely divided that it is not visible. The curd adheres to the plastic butter granules thus giving the butter a high curd content. Fat globules are imprisoned in this cottage cheese and thus a large loss of fat in the buttermilk occurs.

The pasteurization of sour cream causes so much difficulty and loss that it is impractical as a general program. Reducing the acidity with limewater alleviates these difficulties. As the acidity is depressed lower and lower these difficulties lessen. They are practically eliminated when the acidity is lowered to 0.25 per cent to 0.35 per cent (14° to 20° Manns').

Naturally, lime for neutralizing cream should be as pure as possible. The usual impurities are sand, clay, and iron. The first two leave characteristic settlings after slaking. The iron gives the unslaked lime a reddish color. Poor results from lime are much more often due to improper making up than to chemical impurities. Improper mixing produces a granular mixture which imparts to butter a great deal more limey taste than a smooth mixture. This is very noticeable in hot weather when cream is very sour.

The following method produces a smoother lime mixture than any other method we have ever seen: Take 17 pounds of water as hot as you can get it and add to it 3 pounds of powdered or lump quicklime. Do not put this all in at once but add it in four installments with thorough stirring between. Reversing the method and adding water to lime or adding all lime at once is very likely to produce a granular mixture. When cool the mixture is judged by stirring and then dipping into it the hand

to the wrist and observing the smoothness of the mixture on the palm of the hand. If it is smooth like milk it is a good mixture; if two or three particles smaller than pinheads are visible it is a fair mixture; if the palm shows many particles like cottage cheese it is a poor mixture. Cream is neutralized before it is heated much to such an acidity that it has 0.25 per cent to 0.35 per cent (18° to 20° Manns') after pasteurizing. Pasteurization lowers the acidity more or less.

If the cream is to be ripened again the acidity is usually reduced to 0.16 per cent to 0.22 per cent (9° to 12° Manns') and then ripened to about 0.5 per cent (29° Manns').

The best way is to put the cream in a supply vat or forewarmer and then cut the acid to the desired point.

The action of lime is very slow and plenty of stirring and time should be given before concluding that more lime is needed. If the acidity after pasteurizing is too high it should be cut down before starter is added, or before churning.

The more cream is heated before neutralizing the larger the loss of fat in buttermilk. Many losses are caused this way. Some heating is of course necessary to insure mixing. Not much harm is done by holding less than one hour at 90° or a minute or so at 120°. Any temperature above 90° is liable to increase losses if prolonged. The lower the temperature and shorter the time the better.

Any quantity of mixture can be prepared by multiplying the above proportions (17 and 3) by a suitable factor. Five times gives 85 + 15 = 100. This is a 15 per cent mixture. A richer mixture is usually more granular. A thinner one is seldom smoother and is more bulky.

Hydrated lime is preferred by some. It is made up by mixing with cold water to a consistency of rich milk or 15 per cent. If uniformly made up this mixture has uniform strength but is somewhat more gritty.

Either mixture may be used as soon as well mixed or when smooth or the next day.

It is known that 0.3114 pound of dry quicklime neutralizes 1 pound of lactic acid. Hydrated lime is lump lime to which some water has been added. We have found it to contain from 11 per cent to 14 per cent water. Although different brands of hydrated may vary in water content the same brand probably does not vary much and has uniform strength.

Although the best limes do not contain 100 per cent calcium oxide, they usually contain enough magnesium oxide to make up for this and their neutralizing power is close to 100 per cent. If the lime has say 90 per cent neutralizing power as shown by a practical trial in cream, the mixture can be made 10 per cent stronger to fit the table. The greatest obstacle to the use of a table is the drop in acidity caused by pasteurization. This varies with cream, lime, and locality. A user may offset this in the makeup of his limewater. This is always easier to do than to construct a new table. By changing the strength of the limewater this same table can be used to reduce to other acidities, e.g., 0.25 per cent or 0.35 per cent.

When sour cream containing 0.7 per cent of lactic acid is neutralized to 0.4 per cent one is surprised to find that after pasteurization the acidity is only 0.3 per cent or perhaps as low as 0.2 per cent. The sourer and more gassy the cream the more granular the lime, or the more carbonic acid in the sodium carbonate used the greater the drop in acidity produced by pasteurization. It is impossible to foretell in North Dakota what the drop will be in Oklahoma and vice-versa. The extent of the decrease can be ascertained only in the creamery in question.

The loss in acidity brought about by the heating is caused by expulsion of volatile acids, by a more intimate union of limewater and lactic acid, and by expulsion of carbonic acid. Carbonic acid cripples the sensitiveness of the indicator (phenolphthalien). Hence a determination of acidity in raw sour cream is only approximate and reads too high.

Some find a neutralizing table convenient in determining the amount of limewater to be added to cream. The following table is suggested for that purpose.

To reduce acidity to 0.3 per cent

CREAM	INITIAL ACIDITY OF CREAM										
	0.35	0.40	0.45	0.50	0.55	0.6	0.65	0.7	0.8	0.9	1.0
	Pounds of 15 per cent lime water needed										
pounds											
50	0.05	0.1	0.15	0.20	0.26	0.31	0.37	0.41	0.50	0.62	0.72
100	0.10	0.2	0.31	0.41	0.52	0.62	0.73	0.83	1.03	1.24	1.45
500	0.51	1.03	1.55	2.07	2.59	3.11	3.62	4.14	5.18	6.22	7.25
1,000	1.03	2.07	3.11	4.14	5.18	6.22	7.25	8.29	10.37	12.44	14.51
1,500	1.54	3.10	4.66	6.21	7.77	9.33	10.88	12.43	15.55	18.66	21.77
2,000	2.07	4.14	6.22	8.3	10.37	12.45	14.51	16.58	20.74	24.89	29.04
2,500	2.57	5.17	7.77	10.35	12.95	15.55	18.14	20.72	25.92	31.10	36.29
3,000	3.11	6.21	9.33	12.42	15.54	18.66	21.77	24.89	31.11	37.33	43.56
3,500	3.61	7.24	10.88	14.51	18.14	21.78	25.39	29.01	36.29	43.55	50.81
4,000	4.15	8.29	12.44	16.59	20.74	24.89	29.03	33.19	41.48	49.78	58.07
4,500	4.64	9.31	13.99	18.65	23.32	28.00	32.65	37.30	46.66	55.99	65.33
5,000	5.18	10.37	15.55	20.74	25.92	31.11	36.29	41.48	51.85	52.22	72.59
6,000	6.22	12.44	18.66	24.89	31.11	37.33	43.55	49.78	62.22	74.67	87.11
7,000	7.25	14.51	21.77	29.03	36.29	43.55	50.81	58.08	72.59	87.11	101.63

Because of this drop in acidity, a neutralizing table may not always be practical. One trying this table better do so with the consideration that it may not be dependable in his case until verified by actual trial; this notwithstanding that the table is chemically and mathematically correct as far as it goes.

Another fairly accurate procedure is as follows: The quantity of cream and strength of limewater are not known. The acidity is tested and found to be say 0.65 per cent. A measure of limewater is added and reduces the acidity 0.04 per cent or down to 0.61 per cent. Then the total excess acidity is 0.61 per cent − 0.3 per cent = 0.31 per cent. The quantity of lime required to reduce from 0.61 per cent to 0.3 per cent will be 0.31 ÷ 0.04 × measure = $7\frac{3}{4}$ measures. Of course measures also means pounds.

Butter from unneutralized sour cream homogenized with sweet milk yields sweet cream. The lactic acid is in the buttermilk. Indeed the majority of bad flavors are in the buttermilk and not in the butterfat. It is very important to wash the butter quite freely from butter ilk. The more thoroughly this is

done the less off flavor the butter will have. The butter is churned quite cold into granules the size of wheat up to small peas. If larger, or if soft, the buttermilk is sealed in the granules. When the buttermilk is draining a stream the size of the thumb the granules and churn are well rinsed with the hose or a shower bath sprinkler. This crowds out the buttermilk. Then the bunghole is closed and the butter washed in the usual way.

Lactic acid has a much stronger affinity for lime than any other cream constituent. Under these circumstances lime does not act on the butterfat nor any other constituent. It is all taken up by the lactic acid and 0.3 per cent of the lactic acid remains unsatisfied. In the draining of the buttermilk and the washing of the butter the great majority of the lime is eliminated. This is a good reason why butter from neutralized cream often contains less lime than country butter. The cause of this is that buttermilk has not been well eliminated out of the country butter. Lime is a natural constituent of milk and cream being combined with casein. Butter from neutralized cream usually contains from .04 per cent to .07 per cent lime. Unneutralized creamery butter has about the same percentage. In country butter the lime content is sometimes just as low, but in high casein butter the percentage of lime is sometimes 0.11 per cent.

A portion of neutralized butter contains 0.05 per cent or 0.007 grams of lime; a teaspoonful of limewater contains 0.019 grams of lime; a quart of water from a limestone country 0.100 grams; a quart of milk 1.36 grams. A baby often gets a teaspoonful of limewater in a feed of milk. Our mothers gave it and physicians recommend it. An adult would have to eat 1.46 pounds of neutralized butter to ingest as much lime as the bably consumes in one feed of milk.

Lime is an essential constituent of foods. Lack of it causes "lime starvation" and physiological disorders. Two investigators not only recommend but insistently urge the addition of lime to the daily diet. (Calcium Salts as Body Builders, page 372 Review of Reviews, Sept., 1912.)

On page 78 of his "Food Products," Dr. Sherman of Columbia University thus states the need of lime:

> Calcium is present in still greater relative abundance. Milk contains slightly more calcium, volume for volume than does limewater. As a rule the calcium content of the diet depends mainly upon the amount of milk consumed. In family dietaries where ordinary quantities of milk are used, the milk is apt to furnish about two-thirds of the total calcium of the diet. Without milk it is unlikely that the diet will be as rich in calcium, as is desirable whether for the child or for the adult.

Hence, neutralizing cream is not injurious to health.

Neutralization does not abstract any constituent of cream or butter; it does not cheapen its composition or manufacture; it does not lessen its food value. On the contrary, it improves the flavor and keeping quality.

I do not aim to give the impression that all cream offered to centralizers is faultless. I frankly say that a small fraction is contaminated with foreign materials or stale. Such cream is condemned by the buttermakers or by the local food authorities. I strive to make clear the fact that these defects occurred upon the farm and that such cream is offered to creameries operating under every system. I maintain that it is not fair to pillory the whole industry because of the poor condition of one can of cream out of thousands of cans of good cream. Farmers offer or ship their cream to the creameries and the creameries do not know the quality of this cream until it is inspected at the creamery. Creameries welcome honest constructive efforts to improve butter.

Neutralization of cream reduces its acidity, makes possible pasteurization without scorched flavors and excessive losses of fat in the buttermilk, and thus improves the keeping quality of such butter. Neutralization is not a cure-all for stale cream, rancid cream, feed flavors nor any other defects that afflict cream and butter. Neutralization does not enable a creamery to make good butter out of poor cream. Poor cream always makes poor butter.

THE MILK SITUATION IN ONTARIO

J. A. RUDDICK

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The milk situation in Ontario as in the whole of Canada, or in any other country with an exportable surplus of dairy produce, is bound up with the international or world's situation. Local conditions may affect the situation temporarily but with improved storage and transportation facilities, and the extension of commercial organization the upward or downward curves of prices or stocks in any one country are sooner or later flattened out to the general level of the world's markets and requirements. This rule applies more strictly to butter and cheese and other manufactured products than it does to milk itself for the reason that milk does not, strictly speaking, enter into international commerce. Fundamentally, however, the price obtainable for milk is based on the export value of the manufactured product. It follows if the price of cheese or butter is high that the milk distributors must pay a correspondingly high price to secure supplies and on the other hand the price of milk falls in sympathy with a drop in the export value of the surplus of the manufactured products.

This point would seem to be too obvious to need elaboration, and yet there are a large number of otherwise well informed people in this country who cannot understand why dairy products should not be cheap just because milk is plentiful and feed abundant in their particular locality. They are inclined to make sarcastic remarks about the law of supply and demand and the ugly word "profiteer" is too frequently used in this connection.

What these people fail to see is that the law of supply and demand as applied to dairy products operates on a world wide basis and is not very materially affected by conditions in Canada or in any other country. If there is an unusually large production in Canada or New Zealand or any other part of the world, the increase is such a small percentage of the total world's supply

as to be more or less negligible. Furthermore, it usually happens that if production increases in one part of the world it drops somewhere else. The total carry over from one season to another is flexible enough to act as a further regulator.

This world wide basis for the dairy produce trade tends also to preserve an even balance between the different products and prevents overproduction of any single article. A knowledge of world conditions is useful in this connection. That is why the writer has made considerable study of this sort of thing for some years past and has endeavored to disseminate reliable information on the subject.

The stability given to prices by the conditions above outlined are of great value to producers of milk. It prevents the wide price fluctuations which other food products are subject to, the prices of which are determined by supply and demand over limited areas or for which there is no export demand.

Take potatoes for instance. The price was high in 1919 because the short crop was not equal to the local demand and not being an article of international commerce, because of their great bulk in proportion to value and relatively high transportation charges, importation could not be relied upon to make up the deficiency. In 1920 with an excess of supply, which could not be relieved by exportation, prices fell to an unprofitable level.

Or again, take the fruit trade as an illustration. The price of apples in this country depends largely on the demand in the United Kingdom, while the price of small or tender fruits is regulated by local supply and demand. Apples were in good demand for export and brought high prices in 1920, while on the other hand the small fruits of which there was a bigger crop than usual were for some varieties almost a drug on the market. These are important considerations and deserve the attention of both producers and consumers.

Now, of course, the war completely destroyed for the time being the extensive and complicated agencies which are necessary to keep the trade in dairy products running evenly and efficiently. It disorganized transportation, and diminished the

stream of supply from some quarters and completely dried up others. Difficulties of finance, and government purchase and control interfered with private trading. Prices were held up in some cases and kept down in others. An abnormal demand led to overproduction of some products in the end. The whole situation became demoralized, at times exasperating and always very difficult. More recently the varying rate of exchange has created many anomalies.

There is now a loss on the export of Canadian produce, while there is none on shipments from Australia and New Zealand. Denmark has been selling butter to the United States where it is not needed, but simply because the exchange rate was so favorable that it could be landed in New York at less cost than butter could be bought on that market, and at the same time bring a better return to the Danish exporter than he could obtain in England where the selling price is much higher than it is in the States. This state of affairs will continue until there is complete decontrol in the United Kingdom and exchange rates get back to something like parity all round.

As for the matter of control it is well for the sake of clearness to state just what it is at present.

All cheese now being imported into the United Kingdom is free. There is a comparatively small stock of so-called "government" cheese still on hand which comprises the remainder of last year's purchase of Canadian and some New Zealand cheese secured under the contract which expired in August last. This cheese is retailed at 40 cents per pound.

Imported butter is still under control and is rationed at 2 ounces per head per week. So far as I know the only butter contracts now running are those with New Zealand and Australia and these expire on March 31 next. The Chancellor of the Exchequer recently announced, in the House of Commons, that the Ministry of Food would be disbanded at the end of March and it is thought that will be the last of food control in the Old Country, for the present at any rate.

Of course, they have the right to manage their own affairs but the continued control has been the cause of a great deal of

irritation and dissatisfaction which is not lessened any by the fact that their home production has been free for some time and brings a higher price than that which is imported.

As to when the rate of exchange may come back to a parity I am, of course, not able to offer an opinion.

Imports of cheese into the United Kingdom during the past year have exceeded the prewar figures. The principal sources of supply for this article were not interfered with during the war and production was stimulated in some quarters by the high prices. Then again, the large accumulation in New Zealand was brought forward so that receipts from that source have been abnormal. The increased receipts have been met it is said by a very large increase in consumption of cheese in England owing to the high price of meat and increased purchasing power of certain classes of the people.

On the other hand supplies of butter are still far below normal as is indicated by the ration of 2 ounces per week. It so happened that the chief sources of butter supply were either entirely cut off or very seriously diminished. Russia which was second only to Denmark as a butter exporting country before the war has not supplied any worth mentioning since 1915. Production in Denmark is recovering, but a considerable proportion of it has been sold to Germany and other continental countries to say nothing of the shipments to the United States.

Denmark has of late been increasing her shipments to England at lower prices than those obtainable on the Continent, because the prudent Dane knows that the only permanent market of the future will be that of the United Kingdom and he does not care to run the risk of losing it through a little temporary advantage.

Now, when we come to consider market prices in the United Kingdom we are faced with another anomaly. With the drop in prices which we have had in this country and the United States there would seem to be ample justification for the view that the market is lower than it has been, but as a matter of fact prices are higher now in the Old Country than they were at any time during the war or since. I realize that there is cold comfort in this fact for the dealer who can't get more than 48 cents for

his export butter or for the producer who is offered 10 cents less for his output than he got at one time during the summer. It is, however, a fact of some importance, that while prices for other food products have fallen those for dairy produce are still at the maximum in the market which is practically our sole dependence for our exportable surplus and the state of which normally determines prices in this country.

The explanation which is offered is not wholly satisfactory to me but I give it to you for what it is worth.

To go back a little you will probably remember that the British Ministry of Food had a two year contract with New Zealand and Australian producers, which expired in August last, to take their butter at about 38 cents and cheese at 21½ cents F.O.B. shipping point. A new contract was made for butter only, which expires on the 31st March, at 60 cents F.O.B. (280 shillings per 112 pounds). We are told that this butter costs laid down in England 297 shillings per cwt. (112 pounds). There is no loss on exchange. The pound sterling is worth as much in New Zealand or Australia as it is in England, and it is the currency of these countries. New Zealand cheese is free like Canadian.

Last September and October at the opening of their season some cheese sales were made for season's outputs at about 28 cents F.O.B. steamer but a large quantity is being consigned for sale in England, and past experience proves that whenever there is a large quantity coming forward in this way that it has a depressing effect on the market.

When these New Zealand contracts were completed it was announced that the agent of the Ministry of Food in Montreal would buy Canadian butter at a price that would permit of it being laid down in England at the same net cost as the New Zealand. It was even announced that an extra 3 shillings a cwt. would be paid for Canadian butter. Control butter is retailing in England at 80 cents per pound (three shillings and four pence) and British made butter which is free was quoted wholesale in the *Grocer* of December 10 at 400 shillings per cwt. (over 85 cents).

Now, of course, in figuring the cost of Canadian butter laid down in England there must be added to the price paid in Canada the freight and handling charges and, unfortunately, also the loss on exchange which is the big item at present. Even so, I confess that I am unable to understand why the margin between the retail price in England and the Ministry's price in Canada should be so wide, and on the face of it there would seem some justification for the claim that if butter was fully decontrolled a higher price could be obtained for Canadian as in the case of the home production. There are some, however, who take the view that decontrol might bring out such quantities of United States butter as to have the opposite effect. There is undoubtedly a large surplus in that country, which has been increased by the influx of 15,381,954 pounds of Danish.

Those who hold this opinion point to the effect of decontrol on the Canadian cheese market. It is a fact that the price of cheese is lower now than it has been for several years, yet the retail price in England was never as high as it is at the present moment. There is this difference, however, between cheese and butter, as has already been mentioned, that supplies of cheese are fully up to normal while butter is still far short of the requirements. It is certain, however, that the removal of control would receive universal approval, and though there is bound to be a period of readjustment, the market will never reach a state of equilibrium while this artificial condition exists.

Now, I haven't said much so far about the milk situation in Ontario. It is not necessary to say much, because the matters which I have been dealing with are the factors that control the general situation. Whatever the situation may be here it is only a symptom of a world wide condition.

I would, however, like to make a few remarks concerning the position in which a large number of producers found themselves when the condensed milk and milk powder business backed up on them last fall. No matter what the producers may have felt at the time, or may still feel, about it, the fact remains that in the case of condensed milk, at least, it was the inevitable result of the war production which was greatly in excess of peace

time requirements. The crisis, if we may call it such, was probably precipitated by the financial situation, including exchange, and the drop in the price of sugar. But there is no use of crying over spilled milk. The thing to do is to take a lesson from the experience.

Producers should not in these days be placed in a position of dependence on any single outlet for the disposal of their milk. The ideal arrangement, wherever it is possible, would be to have a receiving depot, preferably under the control of the producers, equipped to manufacture cheese and butter, and in large establishments possibly condensed milk or milk powder, and for the sale of milk or cream. The idea has been tried out at the Finch Dairy Station, operated by the Dominion Dairy Branch, with what success I will leave it with you to judge.

The Station was started in 1912. It is located at the crossing of the Ottawa branch of the New York Central Railway and the Montreal-Toronto line of the Canadian Pacific Railroad. The train service is such that the morning's milk or cream can be delivered by noon in either Montreal or Ottawa. The Station is equipped for the manufacture of butter or cheese and for the shipping of milk or cream, pasteurized or not as may be required, but in either case well cooled.

Cheese factories surround the Station on all sides and there is a condensory at Chesterville 10 miles away.

That the patrons have been satisfied with the returns is indicated by the fact that the quantity of milk received annually has increased from 2,069,281 pounds in 1912, to 5,570,545 pounds in 1920. I have been informed that not a single individual milk or cream shipment leaves the Finch railway station, although it is well within the area from which supplies are drawn for Montreal and Ottawa.

The following table gives the record for the nine years of operation.

It will be noticed that there has been an increase in the number of patrons especially during the last two years, but these are mostly winter patrons who come in for a few weeks after surrounding factories close. We have not encouraged patrons to leave competing factories during the summer months.

TABLE 1

YEAR	NUMBER OF PATRONS	MILK RECEIVED	NET RETURN TO PATRONS PER 100 POUNDS	TOTAL AMOUNT DISTRIBUTED TO PATRONS
		pounds		
1912	60	2,069,281	$1.11	$23,304.49
1913	60	2,720,028	1.04	28,214.73
1914	64	2,356,202	1.19	28,108.74
1915	65	2,418,010	1.35	32,640.85
1916	54	2,486,380	1.60	39,779.88
1917	65	2,807,885	2.00	56,173.46
1918	75	3,859,217	2.14	82,785.69
1919	100	5,480,816	2.49	136,540.56
1920	112	5,570,545	2.49	138,792.89
		29,768,364		$566,341.29

The record for 1920 showing the disposal of the milk and rate per 100 paid to patrons month by month may be of interest and help to bring out my point. Here it is.

TABLE 2

Disposal of milk and returns to patrons by months, Finch Dairy Station, 1920

MONTH	CHEESE	BUTTER	MILK SOLD	FAT SOLD AS CREAM	RETURN TO PATRONS PER 100 POUNDS
	pounds	*pounds*	*pounds*	*pounds*	
January			153,216		$3.50
February			107,238	1,272	3.22
March			94,911	7,316	2.70
April		3,441		13,751	2.37
May	12,322	483		20,399	2.49
June	2,395			30,933	2.38
July	33,950	768		13,822	2.24
August	15,703	4,736	32,240	9,540	2.28
September	5,591	9,258		9,367	2.45
October	3,846	1,765	20,000	11,985	2.63
November			31,120	10,040	2.72
December				8,778	2.70
Totals	73,807	20,451	438,725	137,203	
Average for year					$2.492
Total milk received (pounds)					5,570,545

In case you may think that the patrons of the Finch Station have some special advantages in low manufacturing charges or other bonus let me say that they have none whatever. They get a good service for which they pay full rates. It is a strictly commercial proposition, and any advantage there is in it comes through good business management and being in a position always to sell the product for which there is the best market at the time.

The charges for manufacturing are $2\frac{1}{4}$ cents per pound for cheese and 5 cents for butter; for handling milk 12 cents per hundred pounds is charged and for cream 4 cents per pound of fat.

In operating the Station the management makes no lengthy contracts. Prices are determined week by week. The quantity of milk or cream shipped is varied or shipments stopped entirely at a day's notice. Milk distributors can afford to pay, and do pay, a premium for milk under an arrangement of this kind because they avoid surpluses, on which there is always a loss.

I do not offer this plan as a solution for all the producers' difficulties, or as one suitable for general adoption. I am aware that there are many localities to which it would not be adaptable. I see no reason, however, why it could not be followed in many places where there are good shipping facilities or where milk could be sold to condensories or powder factories. The condensor at Chesterville has been a good customer of the Finch Station. It is along similar lines that the Fraser Valley (B. C.) Milk Producers are working, and I believe that organization is the most successful of all similar organizations in Canada.

If a number of establishments like the Finch Station were in operation in Western Ontario they would undoubtedly have a steadying influence on the milk situation as a whole. I have not consulted the milk condensing or milk powder people in the matter, but I see no reason why it would not suit them to secure supplies of milk through such a source, if not regularly at least in times of extra demand. In case a market should be found for all the milk as such the organization would be continued and ready to deal with the milk in some other fashion in case of need.

It is admitted that the most serious aspect of the milk situation which developed when the demand for condensed products fell off last fall, was the closing of the old cheese factories, with their equipment scrapped, even the buildings gone in some instances, the staffs of experienced makers dispersed, and the organization completely broken up.

If I were planning such an establishment, I would make the manufacture of cheese or butter the sheet anchor of the business, and then sell as much milk or cream as I could find a market for at higher prices.

We need never be afraid of serious over-production of either cheese or butter. The market for all we are likely to make is waiting for us, and in the case of cheese at any rate we can command the very top price in the world's markets.

The newer knowledge of nutrition which is being disseminated throughout the world today is a great boost for milk and its products. Even already the signs are not lacking that milk, butter and cheese are being placed higher in the scale of dietary values than they have been in the past.

We may not always get as much for it as we think we are entitled to but it does appear as though dairy produce would bring as high, if not a higher relative price, than most other farm products. Look at the situation today with the price of many products dropping but with cheese and butter still at the peak in the market where prices are determined.

SOILING VERSUS SILAGE FOR DAIRY COWS UNDER NEBRASKA CONDITIONS[1]

J. H. FRANDSEN, J. W. HENDRICKSON, G. C. WHITE,[2] A. C. NORTH[3] AND E. G. WOODWARD[4]

Nebraska pastures do not generally furnish enough feed for dairy cows during the dry, hot summer months. In view of this fact it is generally recognized by dairymen, especially those on high-priced land, that the pastures must be supplemented either by the use of summer silage or by a system of soiling.

The use of either the silage or the soiling system results in an increase in the number of cows that may be kept on a certain piece of land. Both systems are conducive to the greater production of milk and butter fat.

The soiling system easily adjusts itself to conditions where labor is cheap and plentiful and where land is high. In European countries where these conditions prevail soiling has been practiced more widely than in America. However, with the increase in population and the limited area for expansion America may be approaching a condition of intensified agriculture that requires the greater use of soiling crops as a supplement if not as an exclusive summer feed for dairy cows.

Soiling is the growing and supplying of fresh forage to animals kept in confinement. It does not mean, however, that grain is not fed in connection with the forage. This system is generally practiced where intensive farming is carried on and where market milk is in demand. It enables the stockman to concentrate his capital and labor while maintaining a number of animals on a comparatively small acreage of land.

If soiling is to be successful, there should be sufficient rainfall, especially through the growing season. If partial soiling is

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[3] Now engaged in farming in western Nebraska.
[4] Now Professor of Dairying at Washington State College.

practiced—that is, part of the year when the cows would ordinarily be on pasture—eastern Nebraska conditions are well adapted, for sufficient rainfall is obtained nearly every summer. Figures obtained from the United States Weather Bureau at Lincoln substantiate this fact. They are as follows: Average rainfall for the last forty years for eastern Nebraska—29 inches; 1914—26.53 inches; 1915—29 inches. The year 1914 and 1915 are mentioned because the data given later in this discussion were compiled during these years.

Besides sufficient rainfall, a productive, well drained soil is essential because the growing of several crops on one piece of land is a severe drain on the available plant food capable of being liberated during a growing season. In this respect also eastern Nebraska is well favored, there being a deep layer of Loess soil over the major portion. With these two conditions, sufficient rainfall and a rich, well drained Loess soil, soiling can be practiced in every county in eastern Nebraska.

In connection with soil and climate, good markets are essential for the disposal of dairy products, especially when soiling is practiced, for this system is intensive and requires the expenditure of considerable money. Therefore, a ready market is necessary. This fact, that ready and near by markets are essential often necessitates the use of high priced land. Since there is a heavy expense to the soiling system, cheap land is not well adapted because on this kind of land grazing is more economical and does not call for the expense of sowing and harvesting fresh forage; besides, a larger area must be made use of, thus we see that the soiling system is a means of saving land, since a large amount of forage can be raised on a piece of land that would be entirely too small were it used for grazing.

In this experiment five plots 40 feet by 321 feet or an acreage of 1.47 acres furnished enough forage for four cows except some field corn and in 1915 one feeding period of thirteen days when alfalfa was used. If pasture had been used the four cows would have required 8 acres.

Not only is there a saving of land, but also the saving of fencing, for under the soiling system no fences are required.

This is a large saving to the stockman as the initial cost of fencing is considerable and the time spent in almost continual repairing amounts to quite an item during the year.

Quite as important as any of the above items is the value of the manure. Land that is cropped as extensively as when soiling is practiced needs a great deal of humus and plant food. By saving and applying the manure, the fertility of the soil is assured and a continuation of the intensive methods necessitated by this form of farming is possible. The dairy cow is fed concentrates, and the manure made in this manner is much more valuable, besides it can be put on the land which needs it most and can be applied when most needed. If litter is added, the humus content of the soil is maintained and in this way its physical condition is such that a luxuriant growth is possible.

In specialized dairy farming the work of growing and harvesting a soiling crop correlates well with the work of the dairy. During the middle of the day when the cows need but little or no attention, the labor can be employed in cutting and hauling the forage to the cows. In this way the men can be steadily employed and the most efficient labor or the greatest returns from labor is made possible. The men employed exclusively in dairy work will usually appreciate this opportunity of getting into the fields for a short period each day.

The soiling system is of special importance in furnishing a succulent and palatable ration during the time when pastures are short, usually during July and August in many sections. Otherwise, the milk flow would decrease and a decided falling off in revenue would be the result, besides the cows would not return to their normal flow when pastures again become good.

The main objection offered to the soiling system is the labor problem. Regularity in cutting the forage must be adhered to whether the weather is good or bad. Since approximately 100 pounds must be supplied to each cow per day, the labor of handling this amount is considerable.

In addition to the harvesting, a succession of crops is absolutely necessary or the plan will fail if soiling is to be depended on alone. Again, during the latter part of July and the first of August it

may be too dry for the crops to grow or for the seed to even germinate. This would be a serious handicap and must be provided for in this case with forage such as alfalfa, clover, or field corn.

Table 1 shows a plan for soiling crops sufficient for a herd of ten cows. The rotation may be worked out from these dates.

TABLE 1

Plan for ten cows

CROP	DATE SOWN	DATE HARVESTED	NUMBER OF ACRES	YIELD PER ACRE	SEED PER ACRE
				tons	
Rye or wheat	9/15	5/1–5/20	1	5–6	8 pecks
Alfalfa	9/1	5/20–8/10	½	3–6	18 pounds
Canada peas and oats	4/1	5/20–8/10	½	9	6 pecks each
Canada peas and oats	4/10	6/20–6/30	½	9	6 pecks each
Canada peas and oats	4/20	6/30–7/10	½	9	6 pecks each
Alfalfa (second)	9/1	7/1–7/20	½	1–3	18 pounds
Early corn	5/5	7/10–7/30	½	10	½ bushel
Early corn	5/15	7/20–8/10	½	10	½ bushel
Black cowpeas	5/15	8/10–8/20	½	9	4 pecks
Alfalfa (third)	9/1	8/20–9/1	½	2–4	18 pounds
Late corn	5/25	9/1–9/20	½	10	½ bushel
Barley and peas	8/1	9/20–10/5	½	10	1½ bushels each
Barley and peas	8/10	10/5–10/20	½	10	1½ bushels each

TABLE 2

Condensed form of the yield in tons of green feed as well as the dry matter contained per acre

	YIELD PER ACRE IN TONS	
	Green	Dry
Rye	6.5	0.9
Wheat	6.5	0.85
Peas and oats	3.5	0.9
Rape	6.3	1.0
Corn	7.0–8.0	1.5–1.7
Cane	10.3	2.9
Alfalfa		
First crop	5.0	1.5
Second crop	3.0	0.9
Third crop	4.0	1.2
Pasture	2.5	0.5
Silage	8.0	2.4

Alfalfa should stand for five or six years. Vining cowpea should be sown with late corn. Corn or alfalfa may very well be substituted for some of the other less common crops.

A very satisfactory rotation for soiling crops may be worked out for Nebraska conditions using corn and alfalfa as the principal crops, alternating them as much as possible and using just enough of other crops to make connecting links between the cuttings or periods of these two.

OBJECTS

1. To determine for Nebraska conditions the most desirable rotation of soiling crops with respect to yield, date of planting, and date of harvesting, together with an estimate of the cost of growing and harvesting.
2. To determine the value of soiling crops as compared with summer silage in the ration for milk production.
3. To ascertain the comparative economy of butter fat produced by the cows fed on soiling crops and those fed on silage and alfalfa hay.

THE PLAN IN GENERAL

1. Cropping. Five plots of land, 40 by 321 feet in size, were set aside for use in growing soiling crops. In the fall all plots were heavily manured and plowed to a depth of 6 inches, the soil being a rich black loam. This provided for a succession of soiling crops so that abundant green feed might be raised throughout the summer for at least four cows.

In handling these plots exact records were kept regarding preparation of the ground previous to planting, kind and amount of seed sown, method of seeding, rate of seeding, cultivation, date of harvesting, yield per acre, time required to prepare ground for seeding, time required to seed, cultivate and harvest.

2. Crop analyses. These crops were all used for soiling. At the time harvesting was begun on any crop a sample was taken for moisture determination in relation to air dry basis. At the time of completing this harvesting, another sample was taken

for moisture determination to dry air basis. These two samples were then composited on the basis of their fresh weights and a complete analysis made.

3. Feeding. Eight cows were selected for feeding in order to compare soiling crops with silage for milk production.

All of these cows were kept in dry lots. Four of them were fed soiling crops ad libitum from a rack to which they had access day and night except during milking hours. The soiling crop feed was not kept separate for each cow. A supply of the crop was cut fresh each morning at nine o'clock. Refuse was weighed back at frequent intervals so that an exact record of the amount eaten was kept.

These four cows were fed grain (made up of a 4:2:1 mixture of corn, bran, and oil meal (O. P.) in amounts deemed sufficient to keep them in normal production condition, an exact record being kept for each cow. Those four cows received no hay.

The other four cows were fed the same grain mixture, together with alfalfa hay and corn silage. The ratio of 1 pound of grain to 1 pound of hay and 4 pounds of silage was maintained for these cows. This makes a ration very nearly balanced for a cow giving any quantity of milk, provided the total amount fed is regulated intelligently. Exact feed records were kept for each of these four cows.

During the three days in the middle of each crop period a composite sample of the milk was tested for butter fat and the weight of the cows taken. Weighing was done in the morning after feeding but before watering, the cows having been without water all night. This weighing and sampling applied to all eight cows.

4. Basis of comparison. All costs in money values have been eliminated from this study and comparisons made on the basis of total nutrients of the feed or its protein and energy content and on the basis of hours of labor in production. The requirements for butter fat for the soiling group was made upon the total nutrients required and upon labor required for growing the soiling crops including plowing, harrowing, and all cultivation, together with the harvesting—the grain being figured at total nutrient content.

The requirements for butter fat for the silage group was made on total nutrient content of all feeds and labor required for growing silage and putting it in silo.

5. Determination of butter fat. The amount of butter fat for each feeding period was obtained in the following manner for each group separately.

The amount of milk given by each cow during the time the composite sample was taken was multiplied by the per cent fat in the composite sample. The amount of the butter fat thus obtained from all four cows divided by the total amount of milk produced during this period gave the average per cent of butter far for the particular feeding period. The amount of milk given each day was multiplied by the average per cent of fat for the period and this constituted the butter fat for each day, the total of which made up the amount of butter fat for the period.

LABOR REQUIREMENTS FOR CROP PRODUCTION[5]

These values are given in the equivalent of man labor in order that the results may be computed more directly.

	Hours man labor
Growing corn for silage	48.30
Filling the silo	18.82
Total	67.12

The average yield of silage per acre being eight tons, gives a labor requirement on the standard per ton of 8.39 hours labor, alfalfa hay requires 15.61 hours labor per ton.

Tables 3 and 4 provide a summary of the feeding and production for the first summer 1913.

[5] Data obtained from Professor Filley of the Rural Economics Department, University of Nebraska.

TABLE 3

Soiling group for four cows

PERIOD	GRAIN FED	HAY FED	SOILING CROPS FED	BUTTER FAT PRODUCED
	pounds	*pounds*	*pounds*	*pounds*
7-day—1. Peas and oats	312.0	291	1168	32.4
20-day—2. Rape	845.0	655	2911	95.8
25-day—3. Corn	942.0	236	7428	100.7
30-day—4. Cane	309.0	0	3000	37.1
30-day—5. Alfalfa	1095.6	0	4800	117.9
Total				383.9

TABLE 4

Silage group for four cows

PERIOD	GRAIN FED	HAY FED	SILAGE FED	BUTTER FAT PRODUCED
	pounds	*pounds*	*pounds*	*pounds*
First	292	288	1178	30.3
Second	812	611	3766	94.3
Third	888	239	4875	88.8
Fourth	258	225	1520	33.5
Total				284.9

TABLE 5

1914 crop data

PLOT NUMBER	CROP	FALL PREPARATION	LABOR	SPRING PREPARATION	LABOR	HOW SOWN	LABOR	TREATMENT AFTER SOWING	LABOR
			hours		*hours*		*hours*		*hours*
1	Fall wheat	Plowed and harrowed	1¾			Press drill	½		
2	Kherson oats and Canada peas	Plowed	1½	Disked and harrowed	¾	Broad cast	½	Twice harrowed for peas and once for oats	½
3	Fall rye	Plowed and harrowed	1¾			Press drill	½		
4	Swedish select oats and Canada peas	Plowed	1½	Disked and harrowed	¾	Broad cast	½	Twice for peas, once for oats	½
5	White sweet clover	Plowed	1½	Disked and harrowed	¾	Wheelbarrow seeder	¾	June 3, clipped weeds 6″ high	½

PLOT NUMBER	RATE OF SOWING	DATE OF SOWING	HARVEST BEGAN	HARVEST ENDED	YIELD PER ACRE GREEN WEIGHT	REMARKS
					tons	
1	64 pounds per acre	October 18, 1913	May 25, 1914	June 3	13.0	
2	1½ bushels per acre	April 10	June 4	June 13	11.5	Rain nearly every night. Oats quite wet when weighed
3	102 pounds per acre	October 8, 1913	May 14, 1914	May 24	13.5	
4	1½ bushels per acre each	April 10	June 14	June 24	13.1	
5	20 pounds seed in fall per acre	April 13	June 25	July 2	10.7	Some weeds in the forage

TABLE 6

Second crop or sowing, for 1914

PLOT NUMBER	CROP	PREPARATION OF LAND	LABOR	HOW SOWN	LABOR	RATE OF SOWING	YIELD PER ACRE GREEN FEED
			hours		*hours*		
1	N ½ oats and peas	Plowed and harrowed	¾	Press drill	¼	1½ bushels per acre each	2.9
	S ½ cowpeas	Plowed and harrowed	¾	Press drill	¼	102 pounds per acre	8.3
2	Hungarian millet	Plowed and harrowed	1½	Press drill	½	68 pounds per acre	10.2
3	N½ cane	Plowed and harrowed	¾	Press drill	¼	102 pounds per acre	19.26
	S ½ soy beans	Plowed and harrowed	¾	Press drill	¼	68 pounds per acre	6.49
4	S ½ white Kaffir	Plowed and harrowed	¾	Press drill	¼	68 pounds per acre	12.2
	N ½ cane	Plowed and harrowed	¾	Press drill	¼	68 pounds per acre	18.2

In 1915 the same number of cows were used as in 1914—namely, two Jerseys, one Holstein, and one Ayrshire. The same plots were used as in 1914 and were also heavily manured and plowed in the fall of 1914. Besides corn, alfalfa was used as a forage in addition to the crops from the five plots and was cut from a field which was rented. Therefore, in estimating the cost of butterfat, only the rent of the alfalfa ground and time in harvesting were taken into consideration.

TABLE 7

1915 crop data

PLOT NUMBER	CROP	FALL PREPARATION	LABOR	SPRING PREPARATION	LABOR	HOW SOWN	LABOR	TREATMENT AFTER SOWING	LABOR
			hours		*hours*		*hours*		*hours*
1 E½	Rye	Disked, plowed and harrowed	4			Press drill	20 minutes each		
1 W½	Wheat								
2	Kherson oats and Canada peas	Plowed	2	Disked and harrowed, rolled	1½	Press drill	½		
3	Swedish select oats and Canada peas	Plowed	2	Disked and harrowed, rolled	1½	Press drill	½		
4	Kherson oats and Canada peas	Plowed	2	Disked and harrowed, rolled	1½	Press drill	½		
5	Swedish select oats and Canada peas	Plowed	2	Disked, harrowed, plowed	1½	Press drill	½		

PLOT NUMBER	RATE OF SOWING	DATE OF SOWING	HARVEST BEGAN	HARVEST ENDED	YIELD PER ACRE GREEN WEIGHT
					tons
1	102 pounds per acre 64 pounds per acre	October 3, 1914 October 3, 1914	May 1, 1915 May 13, 1915	May 12 May 20	11.7 10.6
2	1½ bushels each per acre	April 12	June 11	June 18	11.2
3	1½ bushels each per acre	April 12	June 19	June 29	11.7
4	1½ bushels each per acre	May 3	June 30	July 8	8.2
5	1½ bushels each per acre	May 3	July 9	July 17	7.6

TABLE 8

Second crops in 1915

PLOT NUMBER	CROP	PREPARATION OF SOIL	LABOR	HOW SOWN	LABOR	RATE	DATE OF SOWING	HARVEST BEGAN	HARVEST ENDED	YIELD GREEN WEIGHT
			hours		*hours*					*tons*
1	Millet	Plowed, harrowed	2½	Press drill	¼	68 pounds per acre	June 2	July 18	July 25	8.2
2	Soy beans yellow	Plowed, harrowed	2½	Press drill	¼	51 pounds per acre	June 26			*
3	Amber cane	Plowed, harrowed, disked	3	Press drill	¼	102 pounds per acre	June 29	September 3	September 27	23.8
4	Millet	Plowed once and harrowed five times	3½	Press drill	¼	68 pounds per acre	July 4	August 27	September 2	5.8
5	Amber cane	Plowed and harrowed	2¼	Press drill	¼	96.6 pounds per acre	July 19	Cut and put in silo	October 11	12.0
1†	Millet	Plowed, harrowed	2½	Drill	¼	68 pounds per acre	July 31	September 28	October 7	7.7

* So weedy was mowed and plowed under.

† Third crop.

TABLE 9

Summary of the feed consumed and the production made by the four cows that were on the soiling system from May 15, 1914, to September 15, 1914. Soiling system

PERIOD	GRAIN CONSUMED	SOILING CONSUMED	MILK PRODUCED	FAT		WEIGHT OF COWS	LABOR REQUIRED
	pounds	*pounds*	*pounds*	*per cent*	*pounds*	*pounds*	*hours*
Rye (May 15–24)	400.0	2,032	1,167.5	5.0	58.34	853.4	10.96
Wheat (May 25–June 3)	403.0	2,965	908.1	4.4	39.98	871.1	13.58
Oats and peas (June 4–13)	429.0	6,453	946.1	4.5	42.57	877.1	14.05
Oats and peas (June 14–24)	441.5	6,121	969.0	4.3	41.67	899.0	17.55
Sweet clover (June 25–July 19)	942.0	13,746	2,094.0	4.4	93.00	868.0	38.25
Corn (July 20–28)	337.5	3,585	765.0	4.25	32.51	875.5	22.75
Cane (July 29–August 9)	450.0	4,860	1,000.4	4.31	43.12	870.2	12.00
Millet (August 10–20)	412.5	3,093	797.6	4.75	37.89	881.0	14.00
Cane (August 21–31)	412.5	4,610	761.1	5.28	40.19	891.0	13.00
Kaffir (September 1–8)	285.0	2,889	508.8	4.70	23.91	905.0	9.66
Cowpeas (September 9–14)	185.0	2,469	335.7	4.80	16.11	900.0	8.00
Total or average	4,698.0	52,823	10,254.0	4.60	469.79	893.34	173.81

TABLE 10

Average daily consumption of soiling per cow as well as her fat production for the summer 1914

	NUMBER OF DAYS	AVERAGE AMOUNT SOILING PER COW PER DAY	AVERAGE AMOUNT MILK PER COW PER DAY	AVERAGE AMOUNT FAT PER COW PER DAY
		pounds	*pounds*	*pounds*
Rye	10	50.8	29.2	1.46
Wheat	10	74.1	22.7	0.997
Kherson oats and peas	10	161.4	23.6	1.06
Swedish select oats and peas	13	117.7	18.6	0.8
Sweet clover	25	137.4	20.9	0.93
Corn	9	99.6	21.2	0.9
Cane	12	101.2	20.8	0.9
Millet	11	70.0	18.1	0.86
Cane	11	105.0	17.3	0.91
Kaffir corn	8	120.0	21.2	0.9
Cow peas	6	137.0	18.6	0.9

TABLE 11

Summary of the feed consumed and the production made by the four cows on the silage system for succulent feed in 1914.

Silage system

PERIOD	GRAIN CONSUMED	SILAGE CONSUMED	HAY CONSUMED	MILK	FAT		WEIGHT OF COWS	LABOR
	pounds	*pounds*	*pounds*	*pounds*	*per cent*	*pounds*	*pounds*	*hours*
Rye	360.0	1,435.0	320.0	1,105.2	3.8	42.00	1,041.0	10.80
Wheat	360.0	1,435.0	345.0	1,086.1	3.58	38.89	1,057.0	11.00
Oats and peas	334.0	1,312.0	378.0	980.2	3.78	37.05	985.4	10.77
Oats and peas	374.0	1,436.6	342.1	1,019.1	3.9	39.74	987.0	11.73
Sweet clover	837.5	3,193.0	705.2	2,191.4	3.97	87.03	996.0	24.66
Corn	276.5	1,114.0	236.0	695.2	3.98	27.67	1,001.0	7.714
Cane	366.0	1,464.0	360.0	938.4	3.81	35.75	1,000.0	11.73
Millet	335.5	1,342.0	327.8	873.2	3.9	34.05	1,000.6	10.738
Cane	335.5	1,342.0	335.5	824.5	4.06	33.36	1,005.0	10.802
Kaffir	244.0	976.0	244.0	543.6	4.06	22.06	1,040.0	7.856
Cowpeas	183.0	732.0	183.0	371.7	4.20	15.61	1,041.0	5.982
Total or average	4,015.0	15,781.6	3,716.0	10,628.6	3.9	413.22	1,014.0	123.69

September 1, one cow taken off the experiment and taken to state fair for educational exhibit.

TABLE 12

Summary of 1914 trial

PERIOD	SOILING GROUP			SILAGE GROUP			
	Grain per 100 pounds milk	Soiling per 100 pounds milk	Labor per 100 pounds milk	Grain per 100 pounds milk	Silage per 100 pounds milk	Hay per 100 pounds milk	Labor per 100 pounds milk
	pounds	*pounds*	*hours*	*pounds*	*pounds*	*pounds*	*hours*
Rye (May 15–24)	34.26	174.22	0.94	32.57	129.84	28.95	0.977
Wheat (May 25–June 3)	44.38	326.50	1.38	33.14	132.12	31.76	1.01
Oats and peas (June 4–13)	45.56	682.06	1.48	34.07	133.85	38.56	1.10
Oats and peas (June 14–24)	45.56	631.37	1.81	36.70	140.96	33.57	1.15
Sweet clover (June 25–July 19)	44.98	656.44	1.91	38.22	145.76	32.18	1.12
Corn (July 20–28)	44.12	468.62	2.97	39.77	160.24	33.95	1.11
Cane (July 29–August 9)	45.00	486.00	1.20	39.00	156.01	38.36	1.35
Millet (August 10–20)	51.71	387.78	1.77	38.20	153.68	37.54	1.23
Cane (August 21–31)	54.19	605.70	1.70	40.69	162.76	40.69	1.31
Kaffir corn (September 1–8)	56.01	567.86	1.90	44.88	179.54	44.88	1.44
Cowpeas (September 9–14)	55.10	732.49	2.38	49.23	196.78	42.23	1.55
Average	47.35	519.91	1.77	38.77	153.77	36.60	1.21

Number of days experiment covered 122.

TABLE 13

Average daily consumption of soiling per cow as well as her production of fat for the summer 1915

PERIOD	NUMBER OF DAYS	AVERAGE AMOUNT SOILING PER COW PER DAY	AVERAGE AMOUNT MILK PER COW PER DAY	AVERAGE AMOUNT FAT PER COW PER DAY
		pounds	*pounds*	*pounds*
Rye	12	93	26.6	1.03
Wheat	8	81	34.0	0.94
Alfalfa	13	109	33.8	1.2
Sweet clover	8	129	33.3	1.3
Kherson oats and peas	8	138	32.1	1.16
Swedish select oats and peas	11	128	29.1	1.15
Kherson oats and peas	9	127	28.4	1.1
Swedish select oats and peas	9	110	27.1	1.05
Millet	8	132	25.7	1.11
Corn	13	115	28.4	0.91
Corn	19	107	24.9	0.99
Millet	7	115	22.7	1.0
Cane	25	104	20.8	0.83
Millet	10	77	15.0	0.70

TABLE 14

Summary of the feed and production of four cows that were on the soiling system for succulent feed, 1915. Soiling system

PERIOD	GRAIN CONSUMED	SOILING CONSUMED	MILK PRODUCED	FAT		WEIGHT OF COWS	LABOR REQUIRED
	pounds	*pounds*	*pounds*	*per cent*	*pounds*	*pounds*	*hours*
Rye (May 1–12)	318.0	3,360	957.6	3.89	37.25	950	14.93
Wheat (May 13–20)	340.0	2,600	1,088.8	4.20	45.73	1,063	12.33
Alfalfa (May 21–June 2)	552.5	5,685	1,757.9	3.76	66.09	1,043	16.25
Sweet clover (June 3–10)	332.0	4,120	1,076.5	4.04	43.49	1,008	14.08
Oats and peas (June 11–18)	288.0	4,430	1,029.2	3.62	37.25	1,024	12.25
Oats and peas (June 19–29)	396.0	2,660	1,281.8	3.97	50.88	1,030	15.00
Oats and peas (June 30–July 8)	333.0	4,585	1,022.9	3.88	39.69	1,027	14.50
Oats and peas (July 9–17)	333.0	3,970	974.9	3.89	37.92	1,027	15.25
Millet (July 18–25)	296.0	4.230	825.3	4.32	35.15	1,024	12.66
Corn (July 26–August 7)	529.5	5,992	1,477.5	3.20	47.28	1,000	34.97
Corn (August 8–26)	836.0	8,128	1,892.6	3.97	75.13	996	59.88
Millet (August 27–September 2)	308.0	3,225	636.6	4.40	28.01	1,024	14.83
Cane (September 3–27)	1,001.0	10,450	2,033.0	4.02	83.74	1,005	50.33
Millet (September 28–October 7)	255.0	3,105	603.2	4.70	28.35	1,081	24.08
Total or average	6,118.0	69,550	16,707.5	3.99	656.45	1021.5	321.34

TABLE 15

Summary of the production and feed for the cows that were on the silage system, 1915. Silage system

PERIOD*	GRAIN CONSUMED	SILAGE CONSUMED	HAY CONSUMED	MILK PRODUCED	FAT		WEIGHT OF COWS	LABOR REQUIRED
	pounds	*pounds*	*pounds*	*pounds*	*per cent*	*pounds*	*pounds*	*hours*
Rye†	426.0	1,624	350	1,289.7	4.45	57.39	1,059	12.29
Wheat	284.0	1,040	231	800.6	4.57	36.59	1,077	8.00
Alfalfa	435.5	1,716	403	1,276.1	4.50	57.42	1,067	13.34
Sweet clover	260.0	1,016	234	777.2	4.20	32.72	1,085	7.94
Oats and peas	261.0	1,000	234	753.5	4.27	32.17	1,071	7.87
Oats and peas	352.0	1,390	317	947.2	4.45	42.15	1,064	10.84
Oats and peas	288.0	1,152	282	716.6	4.45	31.88	1,054	9.11
Oats and peas	245.0	946	222	623.4	3.96	24.69	1,041	7.81
Millet	247.5	889	180	550.7	4.60	25.33	1,041	6.99
Corn	401.0	1,536	310	883.4	4.13	30.48	1,050	11.87
Corn	594.0	2,024	522	1,089.6	4.70	51.21	1,063	17.02
Millet	161.0	644	161	345.5	4.60	15.89	972	5.61
Cane	575.0	1,901	483	1,145.5	4.56	52.23	978	17.72
Millet	230.0	893	227	414.9	5.10	21.16	992	7.88
Total or average	4,760.0	16,681	4,150	11,613.9	4.46	517.23	1,052	254.95

* Three cows only on this feeding period.

† Under "period" is given the soiling crops period merely to designate the corresponding conditions of the silage group and does not mean that these animals received the feed listed under "period."

TABLE 16
Summary of 1915 trials

PERIOD	SOILING GROUP			SILAGE GROUP			
	Grain per 100 pounds milk	Soiling per 100 pounds milk	Labor per 100 pounds milk	Grain per 100 pounds milk	Silage per 100 pounds milk	Hay per 100 pounds milk	Labor per 100 pounds milk
	pounds	*pounds*	*hours*	*pounds*	*pounds*	*pounds*	*hours*
Rye (May 1–12)	33.22	350.87	1.56	33.02	133.64	27.13	0.95
Wheat (May 13–20)	31.23	238.86	1.13	35.50	130.00	28.87	1.00
Alfalfa (May 21–June 2)	31.42	323.39	0.92	34.13	134.48	31.58	1.04
Sweet clover (June 3–10)	30.84	383.64	1.30	33.46	130.76	30.11	1.02
Oats and peas (June 11–18)	27.98	430.43	1.19	34.79	132.73	31.18	1.04
Oats and peas (June 19–29)	30.88	441.56	1.17	37.18	146.75	33.46	1.14
Oats and peas (June 30–July 8)	32.55	448.23	1.41	40.18	160.75	39.35	1.27
Oats and peas (July 9–17)	35.15	407.11	1.56	39.30	157.74	35.61	1.25
Millet (July 18–25)	35.86	512.72	1.53	45.94	161.44	32.68	1.27
Corn (July 26–August 7)	35.85	405.68	2.36	45.39	173.87	35.08	1.34
Corn (August 8–26)	44.16	429.31	3.16	54.51	184.49	47.91	1.56
Millet (August 27–September 2)	48.42	507.07	2.32	46.59	186.49	46.59	1.62
Cane (September 3–27)	48.05	501.68	2.41	50.19	165.95	42.16	1.54
Millet (September 28–October 7)	42.28	514.92	3.99	55.43	215.20	54.71	1.89
Average	36.27	421.1	1.857	41.83	157.70	36.88	1.28

Number of days experiment covered 160. Since the corn fed was cut from field no records were kept to show the labor in production. This was determined from the Rural Economics Department surveys, 48.3 man and horse hours labor per acre to time of harvesting.

The alfalfa feed as soiling was taken from a field and no labor charge was used for the preparation of ground.

The sweet clover plot was used two years with one seeding so the labor of preparation and seeding was divided for two years.

TABLE 17
Average of two years 1914–1915

PERIOD	SOILING GROUP			SILAGE GROUP			
	Grain per 100 pounds milk	Soiling per 100 pounds milk	Labor per 100 pounds milk	Grain per 100 pounds milk	Silage per 100 pounds milk	Hay per 100 pounds milk	Labor per 100 pounds milk
	pounds	*pounds*	*hours*	*pounds*	*pounds*	*pounds*	*hours*
Rye	33.745	262.545	1.25	32.79	131.74	28.04	0.963
Wheat	37.800	283.180	1.25	34.32	131.065	30.31	1.000
Oats and peas	36.280	506.79	1.43	37.03	144.460	35.28	1.158
Sweet clover	31.915	520.04	1.60	35.84	138.26	31.145	1.070
Corn	41.370	434.530	2.83	46.556	172.776	38.980	1.330
Cane	49.080	531.126	1.77	43.290	161.570	40.400	1.400
Millet	44.567	480.625	2.402	46.540	179.170	42.880	1.50
Kaffir	56.010	567.860	1.900	44.880	179.540	44.880	1.44
Cowpeas	55.100	732.490	2.380	49.230	196.780	42.230	1.55
Alfalfa	31.420	323.390	0.92	34.130	134.380	31.580	1.04
Average	41.728	464.257	1.77	40.460	156.975	36.573	1.245

TABLE 18

Showing chemical analysis of all feeds that were used in the soiling crops experiment, per 100 pounds of feed

	DRY MATTER	CRUDE PROTEIN	TRUE PROTEIN	ENERGY
Silage	26.3	1.1	0.6	15.90
Sweet clover	34.4	3.3	2.2	17.30
Canada peas	16.6	2.9	2.1	9.78
Corn	23.1	1.0	0.8	14.60
Rye	21.3	2.1	1.4	15.99
Wheat	27.4	2.8	1.9	18.75
Cane	24.9	0.7	0.4	15 37
Oats	26.1	2.3	2.0	14.06
Alfalfa hay	91.4	10.6	7.1	24.23
Millet	27.6	1.9	1.1	17.24
Oats and peas	21.3	2.6	2.05	11.92
Grain mixture	89.8	12.17	11.15	78.79
Kaffir corn*	14.9	1.1	0.8	13.64
Cowpeas	16.3	2.3	1.7	10.42
Alfalfa (green)	25.9	3.3	1.8	11.50

* No analysis was given for kaffir so dent fodder in tassel was used as a substitute.

TABLE 19

Digestible nutrients required to produce 100 pounds of milk, 1914

PERIOD	BOILING SYSTEM				SILAGE SYSTEM			
	Dry matter	Crude protein	True protein	Net energy	Dry matter	Crude protein	True protein	Net energy
Rye	67.85	7.937	6.995	54.86	89.943	8.468	6.480	53.317
Wheat	129.314	14.55	11.170	95.92	93.529	8.862	6.757	54.812
Oats and peas	186.178	23.291	19.22	117.06	101.016	9.714	7.354	57.441
Oats and peas	175.378	21.97	18.18	111.02	100.594	9.584	7.228	59.445
Sweet clover	266.19	27.05	20.16	149.50	100.52	9.675	7.438	61.07
Corn	147.86	10.068	8.69	103.18	108.875	9.211	7.698	65.024
Cane	161.424	8.892	6.984	110.158	111.131	10.540	8.027	64.819
Millet	153.43	13.673	10.054	107.578	109.037	10.328	7.864	63.506
Cane	199.481	10.85	8.49	145.79	116.537	11.067	8.422	67.725
Kaffir corn	134.898	13.078	10.815	121.582	128.53	12.206	9.289	74.771
Cowpeas	168.876	23.569	18.623	119.744	134.538	12.645	9.691	80.287
Average	162.846	15.902	12.67	112.399	108.564	10.20	7.840	63.837

TABLE 20

Digestible nutrients required to produce 100 pounds of milk, 1915

PERIOD	SOILING SYSTEM				SILAGE SYSTEM			
	Dry matter	Crude protein	True protein	Net energy	Dry matter	Crude protein	True protein	Net energy
Rye	104.436	11.42	8.632	81.321	89.583	8.372	6.425	53.826
Wheat	91.947	10.496	8.034	69.264	92.456	8.821	6.806	55.630
Alfalfa	111.975	14.505	9.340	61.949	94.885	8.989	6.870	55.921
Sweet clover	159.652	16.420	11.893	90.663	91.941	8.710	6.668	54.433
Oats and peas	116.800	14.603	10.836	73.265	94.639	9.008	6.905	56.058
Oats and peas	121.769	15.246	12.508	76.870	102.551	9.694	7.419	60.719
Oats and peas	124.695	15.624	12.823	78.984	114.310	10.839	8.257	66.734
Oats and peas	118.276	14.872	12.281	76.142	107.735	10.236	7.839	63.705
Millet	173.707	14.115	9.655	116.441	113.561	10.843	8.433	69.770
Corn	125.909	8.430	7.260	87.481	118.558	11.166	8.616	71.896
Corn	138.823	9.680	8.379	97.475	141.182	13.754	10.611	83.834
Millet	183.440	15.541	10.901	125.375	133.443	12.671	9.643	77.613
Cane	167.971	9.373	7.387	114.523	127.325	12.414	9.609	76.129
Millet	180.079	14.941	10.398	121.878	156.377	14.928	11.383	91.135
Average	137.105	13.233	10.032	90.830	112.746	10.745	8.248	66.957

TABLE 21

Summary for two years showing the summary of each system of summer feeding for dairy cows

	1914		1915		Average	
	Soiling	Silage	Soiling	Silage	Soiling	Silage
Number of days	122.0	122.0	160.0	160.0	141.0	141.0
Pounds of soiling consumed	52,823.0		69,550.0		61,186.5	
Grain consumed	4,698.0	4,015.0	6,118.0	4,512.6	5,408.0	4,263.8
Silage consumed		15,781.0		16,681.0		16,231.0
Hay consumed		3,716.0		4,150.0		3,933.0
Pounds of milk produced	10,254.0	10,628.0	16,707.5	11,613.9	13,480.75	11,120.95
Average per cent of fat	4.6	3.9	3.99	4.46	4.29	4.18
Pounds of fat	469.29	413.22	656.45	517.23	562.88	465.22
Hours of man and horse labor	173.81	123.69	321.34	254.95	247.57	189.32
Grain required per 100 pounds milk	47.35	38.77	36.27	41.83	41.81	40.30
Soiling required per 100 pounds milk	519.91		421.10		470.50	
Silage required per 100 pounds milk		153.77		157.70		155.73
Hay required per 100 pounds milk		36.60		36.88		36.74
Labor required per 100 pounds milk	1.77	1.21	1.857	1.28	1.813	1.245
Dry matter required per 100 pounds milk	162.846	108.654	137.105	112.746	149.975	110.555
Crude protein required per 100 pounds milk	15.902	10.20	13.233	10.745	14.567	10.472
True protein required per 100 pounds milk	12.67	7.840	10.032	8.248	11.35	8.044
Net energy required per 100 pounds milk	112.399	63.837	90.830	66.957	101.614	65.397
Weight of cows at beginning	853.4	1,041.0	950.0	1,059.0	901.2	1,050.0
Weight of cows at end	900.0	1,041.0	1,081.0	992.0	990.5	1,016.5
Acres of ground required	2.14	1.60	2.75	1.731	2.445	1.665

CAUSE FOR CERTAIN VARIATIONS

The butter fat varies somewhat but there is a gradual rise in feed required for production due to the advance in lactation period. Also, adverse weather conditions cause an increase in the expense. For instance, in the sweet clover period for 1914 there was considerable rainy weather and strong winds. This caused the forage to become badly lodged. This necessitated the expenditure of considerable time in harvesting the crop. In the case of feeding corn much time was expended in cutting up the corn into short lengths and hauling away the refuse stalks.

It will be noticed as well that some of the crops as corn and sweet clover were the only crops obtained from the same piece of land, while other plots of land raised two and some three different crops. This fact was responsible for a less expense because the rent was the same whether one or three crops were raised on the plot.

The reason for the less expense in producing butter fat on the sweet clover for 1914, than for 1915 is due to the fact that the expense of preparation of the soil, sowing the seed, and harvesting are charged to the 1914 account while the harvesting only is charged to the 1915 account.

It will be seen by the above data that in eastern Nebraska soiling can be practiced with profit. The milk flow was kept up, the climate was such that a rotation of palatable forage was possible, the cows showed by their increase in weight that the ration was healthful and nutritious and that there was a great saving in the acreage of land over the pasture system. The main objection, that of labor, remains the same as everywhere but this can be overcome.

This conclusion is not necessarily a plea for the soiling system in eastern Nebraska and the time is not yet at hand when soiling should be extensively practiced, yet it has been demonstrated that soiling is possible, that a rotation of crops can be planned that will furnish forage from the time of early summer until silage is available in the fall or through the summer when pastures are short which condition means a decrease in milk flow.

The special soiling crop plots comprised 1.47 acres and the yield was 26.71 tons of green feed. The sweet clover was grown on special plot which joined the other plots and required .52 acres. The yield of green feed was 6.957 tons. Because of lack of feed the corn used was cut from another field; 0.15 acres yielded 1.63 tons. With these additions the total amount of ground used in the soiling system was 2.14 acres and yielded 35.29 tons of green feed. Not all this feed, however, was used by the cows in the experiment but it should be charged to them because the project was planned for them and on a farm where there were no other animals available, this surplus would have been wasted. The total amount of soiling crop used was 52,823 pounds or 26.41 tons; this being 74 per cent of all feed produced.

The fact that some of the feed was not used for the soiling group together with the fact that certain crops did not give as great yield as was anticipated would tend to show a greater acreage necessary for soiling crops than is ordinarily assumed.

1914 SILAGE SYSTEM[6]

The amount of silage consumed was 7.89 tons.

The amount of alfalfa hay consumed was 3.86 tons.

The average production for Nebraska is 8 tons of silage per acre. Using these figures it required 0.98 acre to produce the silage. The average production for alfalfa is 3 tons per acre would require 0.62 acre; for both silage and alfalfa the total requirement was 1.60 acres.

1914 AND 1915 SOILING SYSTEM

The same plots were used in 1915 as in 1914 comprising 1.47 acres and yielded 31.10 tons of green feed.

The corn used was taken from a plot covering 0.56 acre and yielded 10.36 tons.

The sweet clover was grown on a plot of 0.52 acre and yielded 5.58 tons.

[6] Averages are taken here because the silage and alfalfa hay were weighed up from the general herd supply rather than being produced on separate measured plots.

The alfalfa was taken from plot of 0.2 acres and yielded 2.84 tons.

The total amount of ground used was 2.75 acres and yielded 49.88 tons of green feed. The actual amount fed was 34.750 tons or 69.6 per cent of the amount produced. There was 30.4 per cent wasted, lost or used for some other purpose.

1915 SILAGE SYSTEM

The amount of silage consumed was 8.34 tons.

The amount of hay consumed was 2.075 tons.

It required 1.04 acres for the silage.

It required *0.691 acres for the alfalfa hay.*

The total was 1.731 acres for the silage crops.

The total amount of feed required was greater for the soiling system. One year, the soiling system used more grain per 100 pounds of milk and the other year the opposite condition was true. The average for the two years the soiling crop required a greater amount of grain per 100 pounds of milk. Also under the soiling system there was a greater amount of roughage used.

The soiling crop was of course high in water content and a greater amount of dry matter was also required. As an average for the two years the soiling system produced more milk and a greater amount of fat, which is proportionate to the increased consumption of feed. However, the greater amount of nutrients required under soiling system shows that the soiling was less efficient and more expensive for milk production. As is expected the soiling system required slightly more labor than the silage system and the soiling system, contrary to general belief required a greater acreage.

SUMMARY

1. Soiling crops are successful where rainfall is dependable and palatable feed furnished for dairy cows. The system is well adapted to eastern Nebraska conditions.

2. Soiling crops correlate well with specialized dairying in distribution of labor throughout the day.

3. Succession of crop is necessary for successful soiling system.

4. Fall seeding is necessary in providing soiling crops for the early summer.

5. Cows will maintain a more constant yield throughout the summer on a good ration of soiling crops than on most any other feeds.

6. Cane shows a greater yield per acre than any other of the crops that were used in the soiling system.

7. In 1914, the total hours of labor for the soiling crops was 173.81 as compared with 123.69 hours for silage feeding. Hours of labor per 100 pounds of milk soiling crops 1.77. Silage 1.21. This does not include milking and care of the cow.

8. In 1915, the labor for feed in producing 100 pounds of milk was 1.857 hours for soiling crops and 1.28 hours for silage.

9. The labor requirement for alfalfa as a soiling crop was lower than any other, while the labor for millet and for cowpeas was greatest.

10. The use of either silage or soiling crops for summer feeding of dairy cows decreases the necessity for a heavy grain ration.

ADVANTAGES OF SOILING

1. Permits production of milk free from flavors due to pasture weeds.

2. Furnishes a succulent ration and maintains a continuous milk supply when pastures may be seriously affected by drouth.

DISADVANTAGES OF SOILING

1. It requires a man and team daily to cut and haul a supply of forage to the feeding yards, interfering with the regular farm work.

2. Even with careful planning the season may be such as to hinder the development of the crop with subsequent shortage of feed.

3. Soiling crops must be gathered in all kinds of weather. In rainy weather the feed may be so wet and "washy" as to cause digestive disorders.

4. Another disadvantage of the soiling crop system is that there is always more or less waste. The product is good only for a short time as green feed and if not used then it must be used for some other purpose or it becomes a loss to be charged to the system of management.

ADVANTAGES OF SUMMER SILAGE

1. Feed is always on hand without any additional work.
2. Will keep for an indefinite length of time if properly prepared.
3. Relished just as much as is a soiling crop.
4. Independent of climatic conditions as supply is from previous summer.
5. Silage always under cover, hence does not require harvesting in all kinds of weather.
6. Cheaper succulent feed than soiling crop.

FIG. 1. KHERSON OATS AND CANADA PEAS. EARLY PLANTING

FIG. 2. KHERSON OATS AND CANADA PEAS. LATE PLANTING

FIG. 3. SWEET CLOVER MAY BE USED AS SOILING CROP

FIG. 4. ALFALFA MADE GOOD SOILING CROP. SECOND CUTTING

FIG. 5. MILLET SOWN FOR SOILING CROP

FIG. 6. SWEDISH SELECT OATS AND CANADA PEAS. EARLY PLANTING, 1915

FIG. 7. YOU NEED NOT RAISE CORN OF A SMALL VARIETY FOR SOILING CROPS

FIG. 8. CORN USED FOR SOILING CROPS SHOULD BE PLANTED THICK

ANNUAL MEETING OF THE AMERICAN DAIRY SCIENCE ASSOCIATION

OCTOBER 11, 1920[1]

Meeting was called to order by President Mortensen, who called for a report from the secretary. The secretary's report which follows shows the financial condition of the Association. It was recommended by the secretary that we provide some means for increasing the revenue to the Association.

Following the secretary's report President Mortensen gave the annual address. Among his suggestions were recommendations for a committee on membership, also a committee on program for the annual meeting. President Mortensen also strongly advised that we hold our annual meeting in sections as follows: (1) Relation to breed associations, (2) dairy production, (3) dairy manufacturing, (4) extension workers. During the course of his address our president strongly emphasized the need for workers in both teaching and investigation.

BUSINESS SESSION

Moved by Harding, seconded by Davis that a committee on program and a committee on membership be selected. Carried.

At this point Professor Eckles was called upon to give some interpretations of the membership clause in the new constitution. Dr. Harding also spoke on the question of membership, urging a broader interpretation of the membership clause.

This matter was referred to the committee on constitution for a recommendation to be presented at the next annual meeting.

Professor Mortensen announced that during the afternoon the meeting would be held in sections as previously outlined.

Previous to adjournment Professor Mortensen introduced Mr. A. P. Hansen, dairy expert from Denmark, who spoke briefly of his work to the Association.

Adjourned.

[1] Credit is due President Mortensen and Secretary N. W. Hepburn for preparation of this report.

October 11, Afternoon Sessions

DAIRY PRODUCTS SECTION

At the opening of this session Dean Van Norman was introduced. The Dean spoke very enthusiastically concerning the desirability of holding a world's dairy congress.

Following Dean Van Norman's talk, it was moved, seconded, and carried that the matter of a dairy congress be made a special order of business at the evening banquet.

Moved, seconded, and carried that a nominating committee be appointed to select the officers for the manufacturing section.

Committee selected was Harding, Guthrie, Bouska.

At this point committee reports were called for. Dr. Harding made a report on milk quality which follows:

Report of the Committee on Milk Quality

At its last annual meeting this Association adopted a resolution stating that it "approved of the standardization of milk under proper supervision" and directing its committee on milk quality to get in touch with others interested in this subject.

In accord with these instructions the subject of standardization of milk was presented to the annual meeting of the International Milk Dealers Association. Many of the members expressed themselves as very favorable to the proposition. However, some members opposed the idea as introducing further complications into an already badly mixed situation. Because of this difference of opinion no official action was taken or committee appointed by this Association. From what could be learned there seemed to be little opposition to the principle involved; however, there was the feeling that the success of such an innovation would depend largely upon how it was administered. Accordingly they hesitated to approve standardization, preferrring to leave the initiative to their health officials.

The subject was also brought to the attention of the National Milk Producers Federation. They have a standing committee on milk quality and at their annual meeting this committee presented a report of substantially the same tenor as the resolution adopted by our Association. However, in the discussion of this report from the floor it developed that the question of standardization was under discussion

at some of the larger cities and the sentiment of the producers in these regions was divided in the matter. On this account the report was referred back to the committee with instructions to study the question and report at the coming annual meeting. Conference with the leading members of the Federation developed the fact that the leaders were not opposed to standardization and a number of them were strongly in favor of it. However, as their annual meeting is that of a delegate body they hesitated to commit the organization to any policy regarding a question which had not been presented to their constituency.

As an indication of the present interest in this subject the definition of milk as contained in an ordinance adopted about a year since at St. Paul, Minnesota, is interesting. That portion of the definition relating to standardization follows:

> *Legal milk.*—All milk sold in the City of Saint Paul shall be the fresh, clean normal lacteal product from healthy cows, outside the period of fifteen days before and five days after calving, or until free from colostrum. It shall be free from visible dirt, pathogenic bacteria, objectionable odor, flavor or color, and shall contain not more than two-tenths per cent (0.2 per cent) acidity. It shall contain not less natural butterfat, not less milk solids, not fat, nor less total milk solids than required by the state law, and not more water than permitted by the state law. Its specific gravity shall be not less than 1030 at 60° Fahrenheit, it shall contain no added substance except normal equally pure milk or cream. The mixing or blending of different lots of milk, cream or skim milk which conforms to the standards established by this ordinance for the purpose of standardizing the butterfat content is not prohibited.

It should be noted that this ordinance does not provide for a standardized product having a percentage of fat or solids not fat lower than the state minimum legal limits. This may have been in deference to the state law which would have applied regardless of the city ordinance. It should also be noted that it provides only for the mixing or blending of milk, cream and skim milk. It is of interest that since the passage of this ordinance a local shortage of whole milk led to the manufacture of milk from milk powder, butter and water. A brisk controversy arose as to the permissibility of this action.

While apparently everyone is prepared to subscribe to the proposition that milk should be standardized provided it is so labeled as to inform the consumer of its real food value, skepticism regarding the latter point leads to the following questions:

1. Shall there be a minimum limit below which standardization shall not be allowed?

Those who would answer this in the affirmative seem inclined to fix this minimum composition either at the legal minimum limit or at the estimated average composition. For example, the St. Paul ordinance already quoted placed the limit at the minimum legal limit, and your committee understands that this is the ruling in the State of Indiana. On the other hand in discussions which have occurred in connection with the milk supply of New York State and the City of Milwaukee, 3.5 per cent of fat has been seriously considered as the lower limit of composition for standardized milk.

2. Shall standardized milk be sold under a special label and if so what kind of a label?

If standardized milk is to be treated as a product distinct from milk the food laws require that it carry a distinctive name. According to the present construction placed upon the food laws by a number of food officials "remade milk," "reconstructed milk" and "standardized milk" are not distinctive names for a product which is not milk.

On the other hand it may be contended that when standardized milk contains no substance foreign to milk it is really milk and its present conflict with some of the legal definitions of milk arise from a lack of logic in these legal definitions resulting from framing the laws to accomplish certain purposes. The sharpest difference of opinion arises over the use of milk powder and butter in reconstructing milk. If they are to be considered merely as milk solids, which have been put into a more convenient form for transportation or storage the product of their recombination may be considered as milk. However, if the product of recombining milk powder or condensed milk, butter and water is to be recognized as milk the necessity of some further designation than merely a statement of fat in order to make evident its food value is plain. It will be held by many that this same index of food value is desirable with all milk and if all milk were required to carry an index of food value no special enactment would be needed for reconstituted milk.

3. Assuming that some index of food value should be carried by milk, what index or indices is necessary in order to protect all parties concerned?

There seems to be a consensus of opinion that a statement of fat content is desirable. Where only cream and skim milk are employed in standardizing some feel that the fat content is a sufficient guarantee of food value. On the other hand wherever water is employed in the standardization there is a general feeling that a statement of solids not fat is necessary as an evidence of food value. Should we treat all

milk alike and require a statement of fat and solids not fat regarding all milk?

There seems to be little agreement upon these three points among the various classes interested in the question of milk standardization and your committee respectfully asks your careful consideration of them, with the prospect later of a questionnaire as a medium of expressing your views.

W. A. Stocking, Jr.
R. S. Breed,
E. G. Hastings,
F. Rasmussen,
H. A. Harding,
Chairman.

The following committee on organization was appointed and asked to report next year: Hunziker, Frandsen, Breed, and Gamble.

A brief report on legal standard for butter was made after which the following motion was offered by Bouska and seconded by Harding.

The motion was carried.

Resolved that the chairman of the committee on butter standards keep informed on national hearings regarding butter fat standards and that he submit to the officials conducting such hearings any information or resolutions which have been adopted on butter standard by the American Dairy Science Association. That said chairman be authorized to sign such communications and that said chairman submit these communications to such state bodies or associations as may be required to secure proper consideration of this matter.

Dr. Breed gave the report on bacteriological methods for market milk.

The report as given below was ordered filed.

Report of Committee on Bacteriological Methods for Market Milk

There are two matters brought to your attention in the following report:

1. A discussion of the standard methods for the sanitary analysis of milk recently adopted by the American Public Health Association at their meeting in San Francisco.

2. A discussion of the need of state legislation for the control of bacterial analyses of milk where these are used as a basis for payment to dairymen.

Standard methods for the sanitary analysis of milk. Your committee on bacteriological methods has again been asked to coöperate with the American Public Health Association committee in the preparation of a complete revision of the Standard Methods Report. This was done gladly and it is a pleasure to report that the criticisms and informations furnished by the various members of the committee have proved of very material help to the American Public Health Association committee.

A summary of the most important changes from the 1916 report follows. There are no provisions in the report that will cause a radical change in the methods now in use, although there are many things in it which look toward greatly improved conditions.

1. The newer methods for determining the reaction of agar media are included.

2. Emphasis is placed upon the necessity for a sinple and inexpensive technique for agar plating for general routine purposes.

3. However to safeguard the use of these routine methods where punitive actions are to be taken by control officials, the necessity for securing a series of samples is emphasized, and at the same time it is recommended that wherever actions are likely to be questioned in court that they be based upon analyses made with greater care than that used for ordinary routine work. These are spoken of as verification methods.

4. Because of the present extensive use of the Breed microscopic technique the report accepts this as a standard technique of equal standing with the agar plate count when used for judging the quality of unpasteurized milk.

5. Because of the promise of usefulness in the Frost microscopic agar plating technique as a means of getting quick results on all types of milk, this technique is given with the recommendation that it be given a real tryout by the control laboratories of the country.

6. As the use of these different methods of counting the bacteria of groups of bacteria in milk raises the question of the relation between the counts obtained, it is recommended that the present practice of speaking of agar plate counts as showing the "number of bacteria per cubic centimeter" be discontinued and that the agar plate counts obtained by the routine standard method be referred to as "official plate counts." The ratio between the microscopic count showing the true

number of individual bacteria and the official plate count is tentatively placed at 5 to 1.

7. It will be noted from the title of the report that its scope has been broadened to lower the standardization of the methods officially recognized as useful in the determination of the sanitary quality of milk.

8. As bacterial counts merely give us an approximate knowledge of the amount of bacterial life present, other tests useful in determining the sanitary quality of milk are included. These are primarily the sediment test for visible dirt, and the microscopic examination of milk or of milk sediments for the presence of long chain streptococci. Mention is also made of the possibilities for usefulness of other biochemical or bacteriological tests, and the hope is expressed that investigators and control officials will continue experimental work along these lines.

9. In order to satisfy the demand on the one hand that the report be merely a short and technical statement of required procedures, and an equally insistent demand on the other hand that specific descriptions of procedures be given in order that those unfamiliar with standard procedures might have directions at hands, the committee has prepared a descriptive report with a summary of the required procedures at the end of the report. The American Public Health Association committee feels that this has resulted in placing the cart before the horse: but owing to the press of time it was impossible to recast the whole report so as to place the required procedures at the beginning of the report.

State legislation for the control of bacterial analyses of milk where these are used as a basis for payment to farmers. The recent rapid development of the practice for paying for milk on the basis of the number of bacteria present, and the certainty that the future will see a development of this practice has brought out the necessity for a state supervision of the analytical methods similar to that now exercised in many states over the butterfat test. With minor differences, the conditions are almost identical with those surrounding the use of the Babcock-test. These are already thoroughly familiar to the members of this Association.

It appears that this new legislation should take a very similar form to that already in force regarding the Babcock test, namely, (a) the enforcement of the law should be in the hands of the same bureaus that enforce the butter fat law, (b) analysts doing the work should be compelled to show credentials proving their competence for the work, (c) they should be placed under a license system with the power to revoke

the license placed in the hands of the State, (d) the graduated glassware used should be tested under State supervision, (e) the methods of taking and handling samples should be placed under control and provision should be made for the analysis of the milk by impartial analysts wherever a dispute arises, (f) the law should compel the preservation of records or of microscopic preparations so far as this is feasible or desirable.

It is not necessary to recite the particular conditions that make such legislation desirable. Every bacteriologist knows the possibilities for unfair practices in connection with bacterial counts, and will recognize the need for state control. We therefore request the Association to formulate and pass resolutions urging the necessity for this legislation.

R. S. Breed,
L. A. Rogers,
E. G. Hastings,
B. W. Hammer,
J. D. Brew,
Committee.

It was moved, seconded, and carried that a committee be appointed on the matter of a national dairy congress.

The following committee was appointed: Rawl, Eckles, Breed, Hunziker and Gray.

Committee report on official methods for testing milk, and cream for butterfat. Professor Hunziker gave the report which follows:

Report of Committee on Official Methods for Testing Milk and Cream for Butterfat

Your committee begs to submit the following brief report:

The specifications for standard pipettes adopted at our annual meeting in 1916 read as follows:

Pipette, capacity, 17.6 cc. Total length of pipette not more than 330 mm. (13¼ inches). Outside diameter of suction tube 6 to 8 mm. Length of suction tube 130 mm. Outside diameter of delivery tube 4.5 to 5.5 mm. Length of delivery tube 100 to 120 mm. Distance of graduation mark above bulb 15 to 45 mm. Nozzle straight. To deliver its contents when filled to the mark with water at 20°C., in five to eight seconds. The maximum error shall not exceed 0.05 cc.

The clause "*to deliver its contents when filled to the mark with water at 20°C., in five to eight seconds*" leaves in doubt as to whether the pipette is intended to contain and hold 17.6 cc. of water, or to deliver 17.6 cc. of water when the last drop is blown out. This uncertainty has caused a great deal of confusion and controversy in the construction and calibration of pipettes between officials in charge of the enforcement of standard glassware laws in the various states and glassware manufacturers, and in some cases entire shipments of pipettes have been condemned and returned to the manufacturers by state officials because the pipettes did not conform to their interpretation of the law.

It is obvious that the pipette cannot deliver its contents quantitatively because part of the contents will cling to the walls even though the last drop is blown out. The pipette will *deliver* less than it *holds*.

Your committee has subjected this matter to careful study, and in conference with the United States Bureau of Standards, has concluded that the original intention was that the pipette should *hold* 17.6 cc. and not deliver that amount. We therefore beg to recommend to change the wording of the original specification as follows:

Pipette, capacity 17.6 cc. *of water at 20°C.* The total of pipette not more than 330 mm. (13¼ inches). Outside diameter of suction tube 6 to 8 mm. Length of suction tube 130 mm. Outside diameter of delivery tube 4.5 to 5.5 mm. Length of delivery tube 100 to 120 mm. Distance of graduation mark above bulb 15 to 45 mm. Nozzle straight. *To discharge when filled with water in five to eight seconds.* The maximum error shall not exceed 0.05 cc. *In the operation of the test the last drop of milk should be blown out of the pipette into the test bottle.*

Your committee desires to further emphasize that the length and diameter of the discharge and of the standard pipette are of such proportions that the pipette readily slips into the neck of the standard test bottle. This makes it possible when transferring the milk from the pipette to the test bottle, to drop the discharge stem of the pipette into the neck of the test bottle until the bulb of the pipette rests on the flange of the bottle neck. This greatly enhances the speed of the operation and it avoids all danger of spilling.

HUNZIKER.

It is recommended that instructors in milk testing adopt this method of discharging the pipette into the test bottle in preference to the method of holding the pipette in a slanting position and resting the tip of the pipette against the mouth of the neck of the test bottle, which

latter method is awkward, slow of operation and not suitable for commercial use.

Respectfully submitted,

By the Committee,
L. A. Rogers,
H. C. Troy,
Fred Rasmussen,
F. W. Bonuska,
O. F. Hunziker,
Chairman.

Moved by Gamble that the report be accepted. Carried.

Moved by Frandsen that chairman of the committee on glassware be empowered to get in touch with legislative bodies to give our report the proper publicity. Carried.

At this time Professor Mortensen introduced Dr. Swaiving, Chief of the Dairy division, Department of Agriculture, Holland, and Professor Van Dar Berg, College of Agriculture, Holland. Each of these gentlemen made appropriate talks to the Manufacture Division of the Dairy Science Association.

Report by Frandsen on score card for dairy products.

Score card for milk

	points
Bacteria	35
Flavor and odor	25
Visible dirt	10
Fat	10
Solid, not fat	10
Acidity	5
Bottle and cap	5
	100

The committee does not feel warranted at this time in recommending score cards for ice cream, milk powder or condensed milk, but urges that the committee be continued and additional men be added to the committee and that during the coming year an especial study be made relative to score cards of these products.

Moved that the score card as read for milk be used for one year in our contests in judging milk. Carried.

Professor Frandsen reported further that Dr. Harding had submitted a number of suggestions which in substance would call for very radical change in our present milk score card.

Regarding these suggestions, Professor Frandsen said the committee has as yet taken no action, but he desired that Dr. Harding's recommendations should be published so that all members of the association would be familiar with them and ready to discuss and take action regarding same next year.

Suggestions Regarding the Score Card for Milk

The primary object of the milk score card is to point out the real quality of the milk. The present two score cards for milk differ in their allotment for flavor and odor, fat, and solids not fat. Both allotments are given below and alongside is shown these present cards *rearranged* according to the definition of milk quality which has been adopted by this Association.

Present score cards for milk

		Perfect
Bacteria	35	35
Flavor and odor	25	15
Visible dirt	10	10
Fat	10	15
Solids not fat	10	15
Acidity	5	5
Bottle and cap	5	5
	100	100

Present score cards rearranged

Food value		*Perfect*
Fat	10	15
Solids not fat	10	15
Healthfulness, T.B. test, or Pasteurization	0	0
Cleanliness, visible dirt	10	10
Bottle and cap	5	5
Keeping quality, bacteria	35	35
Flavor and odor	25	15
Acidity	5	5
	100	100

Sanitation bulks large in the discussion of milk and true sanitation means protection from disease germs. The entire omission of such safeguards in the above cards shows that a revision is desirable. Below is given a suggested milk score card indicating the principles which should enter into a proper milk score card.

Suggested score card for milk

	Perfect
Division I:	
Food value	
Fat	15
Solids not fat	10
Division II:	
Healthfulness	25
Division III:	
Cleanliness, visible dirt	25
Division IV:	
Keeping quality, flavor and odor	15
Bacteria	5
Acidity	5
	100

When the score of each division is 20 or above the milk is GOOD.
When the score of each division is 23 or above the milk is EXCELLENT.

A card like the above would assist in grading a city milk supply.

Report of committee on legal standard for ice cream. This report was prepared by Professor Ruehe and in his absence read by the secretary.

The report was referred back to the committee for further consideration.

Report by Professor Potts on dairy statistics.

This report was adopted, but has not been received by the secretary.

Reports on results of the dairy products judging contest by Professor White follows:

AWARDS

Team having highest grade on all products.—The National Dairy Association Cup: To Ohio State University.

Individuals having first, second, and third highest grades on all products.—The National Dairy Association medals: A. H. New, Ohio State University, Gold Medal; C. Farr, Iowa State College, Silver Medal; T. V. Armstrong, Ohio State University, Bronze Medal.

Team having highest grade on butter.—The J. G. Cherry Cup: To South Dakota State College.

Team having highest grade on cheese.—The Hoard's Dairyman Cup: To Ohio State University.

Team having highest grade on milk.—The J. B. Ford Cup: To Ohio State University.

Teams placing all products

	Grade
Ohio State University	8458.665
Maryland University	8393.874
Iowa State College	8393.758
South Dakota State College	8345.832
Purdue University	8251.374

Contestants placing all products

	Grade
1. A. H. New, Ohio State University	2836.583
2. C. Farr, Iowa	2834.500
3. T. V. Armstrong, Ohio	2822.666
4. J. H. Snyder, Maryland	2817.875
5. Geo. Biggar, South Dakota	2815.916
6. Chas. Reynolds, Maryland	2808.291
7. Homer J. Kline, Ohio	2799.416
8. D. A. Salisburg, Iowa	2796.250
9. Richard Gardner, South Dakota	2780.458
10. W. I. Poe, Purdue	2779.208
11. J. R. Graham, Maryland	2767.708
12. John A. Nelson, Iowa	2763.008
13. Clifford Peck, South Dakota	2749.458
14. G. J. Brown, Purdue	2736.166
15. Paul Blackburn, Purdue	2736.000

Report of team placing butter

	Grade
1. South Dakota State College	2895.0
2. Iowa State College	2887.0
3. Ohio State University	2887.0
4. University of Maryland	2879.5
5. Purdue University	2854.5

Report of team placing cheese

	Grade
1. Ohio State University	2730.000
2. Maryland University	2704.375
3. Iowa State College	2688.125
4. South Dakota State College	2682.500
5. Purdue University	2661.875

Report of team placing milk

	Grade
1. Ohio State University	2841.659
2. Iowa State College	2818.333
3. Maryland University	2809.999
4. South Dakota State College	2768.332
5. Purdue University	2734.990

Report of contestants placing butter

	Grade
1. J. H. Snyder, University of Maryland	981.0
2. Geo. Biggar, South Dakota State College	973.0
3. D. A. Salisburg, Iowa State College	965.0
4. C. Farr, Iowa State College	964.5
5. A. H. New, Ohio State University	964.5
6. T. V. Armstrong, Ohio State University	963.5
7. J. R. Graham, Maryland University	963.5
8. Richard Gardner, South Dakota State College	961.5
9. Clifford Peck, South Dakota State College	960.5
10. Homer J. Kline, Ohio State University	959.0
11. John A. Nelson, Iowa State College	957.5
12. W. I. Poe, Purdue University	954.0
13. Paul Blackburn, Purdue University	951.0
14. G. J. Brown, Purdue University	949.5
15. Charles Reynolds, University of Maryland	936.0

Report of contestants placing cheese

	Grade
1. Chas. Reynolds, Maryland University	925.625
2. F. V. Armstrong, Ohio State University	917.500
3. A. H. New, Ohio State University	913.750
4. Richard Gardner, South Dakota State College	905.625
5. C. Farr, Iowa State College	905.000
6. J. H. Snyder, Maryland University	904.375
7. W. I. Poe, Purdue University	904.375
8. George Biggar, South Dakota State College	901.250
9. Homer J. Kline, Ohio State University	898.750
10. D. A. Salisburg, Iowa State University	898.750
11. John A. Nelson, Iowa State College	884.175
12. G. J. Brown, Purdue University	882.500
13. Clifford Peck, South Dakota State College	875.625
14. Paul Blackburn, Purdue University	875.000
15. J. R. Graham, Maryland University	874.375

Report of contestants placing milk

	Grade
1. C. Farr, Iowa State College	965.000
2. A. H. New, Ohio State University	958.333
3. Chas. Reynolds, Maryland University	946.666
4. F. V. Armstrong, Ohio State University	941.666
5. Homer J. Kline, Ohio State University	941.666
6. Geo. Biggar, South Dakota State College	941.666
7. D. A. Salisburg, Iowa State College	932.500
8. J. H. Snyder, Maryland University	932.500
9. J. R. Graham, Maryland University	930.833
10. John A. Nelson, Iowa State College	920.833
11. W. I. Poe, Purdue University	920.833

	Grade
12. Clifford Peck, South Dakota State College	913.333
13. Richard Gardner, South Dakota State College	913.333
14. Paul Blackburn, Purdue University	910.000
15. G. J. Brown, Purdue University	904.166

Moved by Washburn that ice-cream be included among the products for the dairy judging contest. Carried.

Moved, seconded and carried that a committee be appointed to discuss with Colonel Skinner, secretary of the Dairy Show the questions of increasing the number of medals for student judging contests. Carried.

The following were elected as officers of the manufacturing division: Roy Potts, chairman; W. P. B. Lockwood, vice-chairman; Rudnick, recording secretary.

Afternoon session adjourned.

Banquet

The annual banquet of the Association was held at the Hotel Sherman.

Our honored guest of the evening was President R. A. Pearson of Ames, Iowa, who gave us a very inspiring address.

Talks were also made by Dean Van Norman and Chief Rawl, two men who have during these past years been a source of strength and inspiration to the Association.

Chief Rawl moved that our Association go on record favoring an international dairy congress to be held in the fall of 1922. Carried.

The following committee was named with power to act, on matters pertaining to the dairy congress: Chief Rawl, Professor Eckles, Professor Breed, Professor Hunziker, C. E. Gray, Professor Mortensen, and Professor Erf.

Professor Frandsen gave an interesting talk regarding the Journal of Dairy Science.

The following resolution was passed:

The American Dairy Science Association urges the passage of laws by state legislatures to control the making of bacteriological analyses

where these are used as the basis of payment. These laws should be similar in general form to those already in force for the control of the butterfat test.

Banquet adjourned.

Minutes of the Meeting of the Advanced Registry Testing Section of the American Dairy Science Association, Held at Chicago, Illinois, October 11, 1920

The following men were present at the meeting:

H. P. Davis, Idaho
C. H. Eckles, Minnesota
W. L. Gaines, Illinois
C. W. Larson, Washington, D. C.
J. R. Dice, North Dakota
J. H. Frandsen, Nebraska
J. A. Gamble, Maryland
C. E. Wylie, Tennessee
J. M. Fuller, New Hampshire
E. B. Fitts, Oregon
E. G. Woodward, Washington
C. W. Turner, Missouri
C. R. Gearhart, Kansas
C. A. Iverson, Iowa
F. W. Well, California
W. J. Fraser, Illinois
W. W. Swett, Missouri
M. M. Regan, New Jersey
A. C. Ragsdale, Missouri
Helmer Rabild, Washington, D. C
H. E. Van Norman, California
O. Erf, Ohio
T. M. Olson, South Dakota
L. H. Fairchild, Indiana
J. B. Fitch, Kansas
B. R. Rogers, Chicago, Ill.
R. H. Mason, Arkansas
R. S. Hulce, Wisconsin
M. H. Campbell, Illinois
A. A. Borland, Pennsylvania
R. T. Harris, Wisconsin
M. H. Fohrman, Minnesota

Meeting called to order by the temporary chairman, Mr. Eckles.

H. P. Davis of Idaho was unanimously elected permanent chairman of the Section.

M. H. Fohrman of Minnesota was elected permanent secretary of the Section.

Motion made that a committee be appointed to draft rules of eligibility, officers, and all other matters necessary for the permanent organization of the Advanced Registry Testing Section of the American Dairy Science Association. Motion carried.

Chairman Davis appointed the following to act on this committee: E. G. Woodward of Washington, R. T. Harris of Wisconsin, W. J. Regan of New Jersey.

Report of the committee on relation to breed associations. This committee was made up as follows: C. H. Eckles, Minnesota (chairman); R. T. Harris, Wisconsin; W. W. Yapp, Illinois; H. H. Wing, New York; G. C. White, Connecticut; E. G. Woodward, Washington.

Chairman Eckles read the following report of this committee:

REPORT OF THE COMMITTEE ON RELATIONS TO BREED ASSOCIATIONS

At the last meeting of the Dairy Science Association a recommendation by this committee was adopted as follows:

> That the experiment stations or colleges in vouching for official tests, stamp each report with a statement exempting the institution from any legal responsibility for the accuracy of the tests.

The chairman of the committee was instructed to formulate with legal advice a proper statement for this purpose and to send a copy of this statement to each superintendent of official testing. This was carried out as directed. The statement as formulated was as follows:

> That this report is vouched for with full confidence in its accuracy, but is not guaranteed by the ———— and is subject to cancellation for error.

This statement is a modification of that which has appeared for several years on Holstein pedigrees. No information has been gathered as to how generally such a statement has been adopted by the various state superintendents.

The following resolution was also adopted:

> That the American Dairy Science Association recommend to the Association of Agricultural Colleges and Experiment Stations that all dairy breed associations be requested to relieve the colleges and experiment stations after October 1, 1920, of the supervision of official dairy tests where the test period is less than ten months in length.

The committee was directed to forward this resolution with a suitable explanatory statement to the executive committee of the American Association of Land Grant Colleges. Such a statement was proposed by the chairman of your committee and sent with the resolution to President Thompson of Ohio State University, the chairman of the executive committee.

His committee declined to consider the matter on the grounds that it is a local issue and therefore does not come within the field of their deliberations.

Following the annual meeting of the American Association, a new executive committee was appointed of which President Pearson of Iowa is chairman and President Riggs of South Carolina, President Stone of Purdue, Dean Russell of Wisconsin and Dean Mann, Cornell, members.

The matter was again presented to this new committee with the same results. Apparently this Association of Deans does not see fit to officially consider the problems of official testing. However, through the offer of a prominent dean to call a special conference for the purpose, an opportunity is offered of having our recommendations considered unofficially by a group of the deans most interested.

At a meeting of your committee last year, a subcommittee consisting of Harris of Wisconsin and Yapp of Illinois was appointed to consider the matter of financing official testing. During the year this subcommittee submitted a statement to the Dairy Breed Associations for their consideration and a recommendation concerning the matter is later presented for your consideration.

In preparation for this meeting, the chairman of your committee asked each superintendent of official testing to submit such matters as he desired for the consideration of your committee. A résumé of these suggestions was submitted to the committee for consideration and discussion. As a result of the deliberations of your committee, certain recommendations are submitted for your consideration. It is suggested that these recommendations be made the first order of business and that later opportunity be given for a general discussion of official testing problems, the suggestions presented to the committee to form a program for such discussion.

The following recommendations were made by the committee:

Resolution Number 1

WHEREAS: (1) In 1914 the American Science Association adopted the following statement concerning the relation of the agricultural colleges and experiment stations to the breed association in regard to official testing as follows:

> It is not the province of the agricultural colleges to undertake the control in any way of the rules and requirements for advanced registry adopted by the several breed associations. The interest of the colleges in this matter is purely an advisory one.

Inasmuch as the colleges are called upon to conduct the tests for advanced registry and to stand responsible for the accuracy of the results reported it is their right to formulate the rules governing the conduct of the tests and the work of the supervisors. The relation of the breed associations to this work is only an advisory one.

(2) The superintendents of official testing for the Holstein-Friesian, Guernsey, Ayrshire and Brown Swiss Breed Associations have by direct statement or by implication from the statement of their rules and from their attitude in dealing with state superintendents of official testing accepted the substance of this statement and recognize the full responsibility of the state superintendent of official testing for the conduct of all official testing in his state.

(3) The American Jersey Cattle Club has never in its dealings with the various superintendents of official testing conceded the full responsibility of the state superintendent for the conduct of tests in his state and have adopted certain rules in variance with the standard rules for the conduct of official testing approved by the American Dairy Science Association. These rules and this general attitude on the part of the Jersey Cattle Club has been the cause of much friction between the breeders and the superintendents of official testing.

For these reasons we request, and insist upon, the following action by the Jersey Cattle Club or by its superintendent of the register of merit.

1. The recognition of the full responsibility of the superintendent of official testing for the conduct of all tests within the state.

2. That the rules for the conduct of official testing as published in the handbook issued by the Jersey Club be modified to conform to the rules for the conduct of tests as approved by the American Dairy Science Association. In this connection we recommend, but do no insist upon the publication of these standard rules and the elimination of all other rules concerning the conduct of tests except such as may be deemed necessary to supplement these rules.

Resolution Number 2—Financing official testing

WHEREAS: (1) The rapid increase of official testing has placed a severe financial burden upon the experiment station or college taking the responsibility. Even when all charges are assessed to the breeder a large revolving fund or free balance is necessary, amounting to from $500 to $10,000 in different states. Many experiment stations are

finding it difficult to carry this burden. In the opinion of this Association this burden should be borne by the breed associations for whom the testing is done.

(2) The collection of bills for official testing by the superintendent of official testing causes more or less strained relations at times between his institution and the breeders, and furthermore under present arrangements the recourse of the superintendent of official testing in case of delay of payment of bills is inadequate.

For these reasons we ask the breed association to adopt the following plan:

1. The collecting of all bills for advanced registry testing be done by the national association for which the testing is done.

2. The state supervising the test to render a bill covering the cost of supervision to the national association. The same to be accompanied by the supervisor's authenticated report of the test.

3. The breed association to make payment direct to the experiment station immediately upon receipt of the test reports properly made and the bill properly rendered. Any errors to be corrected later.

4. The experiment station to be responsible for the accuracy of the bill rendered and any error or discrepancy on the part of the experiment station to be properly adjusted by them.

As a means of bringing this about we recommend

(1) A conference of the committee on relation to breed associations with representatives of the breed associations.

(2) That each superintendent of official testing be urged to bring the matter to the attention of the administration of his institution.

(3) That the matter be brought before a conference of deans and directors if found possible.

Resolution Number 3

This Association reaffirms its position as taken in 1913 and 1917 concerning the authentication of cow test association records. The resolution as passed at the eleventh annual meeting in 1917 was as follows:

It is the sentiment of this body that records supervised by cow testing association employees should not be authenticated unless the supervisor selected and employed by the superintendent of official testing in that state, and that the work be done in strict accordance with the rules adopted by the Official Dairy Instructors' Association for the conduct of official tests, and further that even in

states where cow testing association records are authenticated under these conditions the practice should be discontinued as promptly as more satisfactory arrangements can be made.

The committee on relation to the breed association is directed to call the attention of all deans of agricultural colleges and superintendents of official testing to this recommendation of the American Dairy Science Association.

In addition the committee recommends that after these matters are considered and acted upon, a general discussion be held of other matters concerning official testing.

Eckles moved that the recommendations of the committee on relation to breed associations be adopted as read. Seconded.

Discussion followed.

Eckles called attention to the action taken by this Association in 1914 defining the relation of the colleges and breed associations regarding testing which is set forth on pages 4 and 5 of the printed report of committee on relation to breed associations and is as follows:

It is not the province of the agricultural colleges to undertake to control in any way the rules and requirements for advanced registry adopted by the several breed associations. The interest of the colleges in this matter is purely an advisory one.

Insomuch as the colleges are called upon to conduct the tests for advanced registry and to stand responsible for the accuracy of the results reported it is their right to formulate the rules governing the conduct of the tests and the work of the supervisors. The relation of the breed associations to this work is only an advisory one.

He also called attention to a recent change in the rules of the American Jersey Cattle Club governing the supervision of register of merit tests, regarding the number of cows to be supervised at one time.

Relative to financing official testing, the committee suggests that the breed associations carry the burden.

Attention was called to the fact that in some states there is dissatisfaction brought about through the acceptance of cow test association records in neighboring states.

At this point Mr. H. E. Van Norman requested the body to consider whether or not it would be desirable for the dairy interests to take the initiative in holding a world's dairy congress in this country for the consideration of all phases of the dairy industry: the expenses to be provided for by Congress and the dairy industry.

It was moved that this Section concur in making this matter a special order of business for the evening meeting of the American Dairy Science Association as a whole. Carried.

The meeting proceeded to further discussion of the recommendations of the committee.

Regan of New Jersey suggested that a definite stand should be taken against the action of the American Jersey Cattle Club in sending a check supervisor into a state without the consent of the college, and also that the colleges should oppose the change in their rules regarding the number of cows to be milked at one time. The colleges should insist that the American Jersey Cattle Club recognize the superintendent of official testing as the man who has control of official testing in the state when it comes to rules that directly affect the authentication of the test.

Fohrman of Minnesota recommends that the American Jersey Cattle Club be requested to change their rules governing the supervision of the test to conform to those of the American Dairy Science Association.

Fitch of Kansas expressed the same sentiments.

Regan inquired as to what method would be used to put the matter up to the American Jersey Cattle Club.

Eckles said this matter would be handled by the committee on relation to breed associations.

Woll of California agrees that the superintendents should be in absolute control of the tests, but the matter of preliminary milkings should be left to the breed associations.

Regan inquired how many other states besides California were varying from the American Dairy Science Association rules.

Indiana: No preliminary milking required.

California: No preliminary milking required and breeders allowed to milk two cows at a time.

Washington: No preliminary milking required.

Tennessee: No preliminary required on Jerseys.

Arkansas: No preliminary required.

North Dakota: No preliminary required.

Ohio: The superintendent uses his discretion regarding preliminaries.

Idaho: Follow rules of breed associations on preliminaries.

Iowa: The superintendent uses his discretion regarding preliminaries.

Regan suggested that the colleges agree unanimously to follow the rules of the American Dairy Science Association, and that if these rules need revision, proper action be taken.

Fuller of New Hampshire recommends that all Stations adopt the uniform rules of the American Dairy Science Association.

Erf of Ohio suggests a conference between representatives of the colleges and breed associations. All colleges should agree to one general plan of action, and if a meeting of the breed associations could be called and the matter laid before them, they would all adopt these rules.

Ragsdale moved that the original motion be amended and that the first recommendation of the committee be approved as read. Motion carried.

The second recommendation of the committee on relation to breed associations was taken up for consideration.

Recommendation read by the secretary.

Motion made by Regan of New Jersey that the second recommendation be adopted as read. Seconded.

Discussion of plans for financing official testing.

Fohrman briefly outlined a plan which had been discussed at a meeting of representatives of the breed associations of having a committee in each state composed of representatives of each breed to lobby for an appropriation by the state legislatures of a sufficient fund to be used as a revolving fund to finance the official testing in the various states.

Davis suggested a regional plan for supervising official testing, the work to be subsidized by all breed associations with a superintendent in charge of each region, to consist of a single state or group of states, according to the volume of business.

Fuller raised the question, "is advanced registry testing educational or commercial."

Regan replied that in Nevada he considered it educational but in New Jersey commercial.

Eckles stated that the deans of some of the colleges are asking if official testing is a college function.

Fitch said that during his ten years in Kansas he considered official testing educational for the first six or seven commercial for the last three or four.

Erf of Ohio advised that when no funds were available to take care of official testing bills in his state the breed associations brought pressure to bear on the legislature to provide necessary funds.

Davis feels that the breed associations should assume more financial responsibility for official testing and should be compelled to do so.

Motion to adopt the second recommendation of the committee was carried.

The third recommendation of the committee was read by Chairman Eckles and discussion opened.

Erf of Ohio, outlining the work as carried on in his state, said that all supervisors are civil service men and must pass an examination. When a cow test association employs a civil service man he has the right to devote part of his time to official test work. It is not a combination of official and cow test association, but the same man is used for both, provided the cow test association will employ a civil service man. Ohio does not authenticate cow test association reports as official.

Davis of Idaho said that with one exception all testing in his state was carried on through cow test associations. This allows men to do official testing work in widely scattered communities. Every cow tester is approved by the man in charge of official testing and required to pass an examination on official testing. The time he devotes to official testing he is in the employ of the college and paid by the college and responsible to the college. Men are changed from one association to another. Colleges have reserved the right to see that three different men supervise work during the year.

Fuller reported that New Hampshire has a similar arrangement to that of Idaho.

Rabild stated that while the supervision of official testing is entirely in the hands of the colleges, it will help cow test association work if such combinations are permitted.

Moved and seconded that the third recommendation of the committee be adopted. Carried.

Moved and seconded that the recommendations adopted be adopted entire. Carried unanimously.

Motion made by Regan that any superintendent of official testing that finds a herdsman or supervisor who is dishonest should report that fact at least to adjoining states and to the superintendents of the various breed associations, with request that they report to parties in any state who may be interested. Seconded and carried.

Gamble of Maryland moved that the secretary gather information in regard to charges for official testing, pay of supervisors in the different states, etc., and submit this information to the various colleges. Motion seconded and carried.

Erf of Ohio suggests that the state breed associations appoint one man each to select a superintendent of official testing who would have charge of the supervisors of the state and vouch for the records.

It was moved that the suggestion be made on the reports of the committee to the breed associations that they adopt a uniform blank for reporting official tests. Seconded and carried.

A general discussion was held of topics of interest to superintendents of official testing and parties connected with test work at the colleges. There were exchanges of ideas and experiences, and suggestions for improving the work.

Adjournment followed.

M. H. FOHRMAN,
Secretary.

OPEN FORUM

The following letter describes very vividly conditions said to maintain in Hungary at this time. I thought possibly some of the members of the American Dairy Science Association would find it possible to give assistance of one kind or another, and I am therefore publishing the letter in full.

J. H. FRANDSEN,
Editor-in-Chief.

M. KIR. TEJKISERLETI ALLOMAS.

To the

American Dairy Science Association:

Sir!

The present condition and the future of the Hungarian scientifical institutions as well as of the Royal Hungarian Dairy Experiment Station is perhaps you know it extremely desolate. The utensils necessary to scientifical researches, our chemicals, books and periodicals are mostly of foreign origin and can not be bought nor repaired in consequence of the low state of the financial standard and because the revenues of the Experiment Station are very small. We are prevented to read foreign journals and to learn anything about the progress of modern science. The Hungarian state became poor and unable to raise our income according to the present immoderate prices. Our station receives for its purposes no more than 10,000 crowns yearly; from this small sum we are to pay also our employees, from this we must provide for heating, lighting, for the requirements of the laboratories. To do all this is quite impossible.

Beside that the Dairy Experiment Station has been entirely knocked down by the Roumanian invasion. In the year 1919 at spring time it was transferred to the environs of Budapest in order to accomplish better its scientifical aims. The fittings of the laboratory were not as yet unpacked when the Roumanian invaders came in our country and took all we have had with the only exception of the furniture and of the library. We were obliged to return to Magyarovar completely despoiled by the plunder. We have lost all the chemical and bacteriological utensils of the laboratory and partly our apparatuses.

By this deprivation the Station became lame. Without kind help we are for long time excluded from every scientifical progress, we have

taken part of before the war as demonstrated by some subjoined prints of our scientifical records. Old merry Hungary exists no more rent into pieces, important dairy districts point of view are given to the surrounding nations. In consequence thereof the support of the Station granted by the state grew insignificant.

Notwithstanding we desire to work, we desire to be useful in science. But whereof may we want for help? To whom may we apply? It is sorry, we want the support of foreign countries, because we have nothing. The generous people of the United States of America has done very much good for our country and for our people while the war endured it can help us easily. The low value of the Hungarian crown makes it possible that a comparatively small sum of your grew to a very important one when taken in our value.

We request of your benevolence, in name of the Royal Hungarian Dairy Experiment Station to take your part in supporting our scientifical inquiries relating dairy. Your help might consist either in financial aid or in sending utensils required to experiments, in prints of the American experiment Stations journals, newspapers, new books related to dairying. To avoid the eventual receipt of materials unwished for it was advisable to communicate our needs to you.

We recommend once more our petition to your benevolence.

Respectfully,

ROYAL HUNGARIAN DAIRY EXPERIMENT STATION,
M. KOR. TEJKISERLETI ALLOMAS.
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